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Collective Review

HYPOTHERMIA

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THE PRACTICAL VALUE of hypothermia is due to the reduced metabolic activity which, theoretically at least, may be slowed to any desired degree, even to a level which permits prolonged viable storage at temperatures far below freezing. Many possible applications of this reduced metabolic activity have been suggested. Local application of cold for injuries can apparently be traced as far back as Hippocrates (91), though it doubtless preceded him in folk medicine. General body cooling must also have interested man from the time he recognized that all species did not have the same temperature at all times. Stories of fish that survived freezing are ancient and recurring and an awareness of the "frozen sleep" of hibernating animals must often have filled man with a wish that in certain dire circumstances he might imitate it. Fantastic ideas have always charmed the daydreamer, as they do now, but serious study and successful application of hypothermia are relatively recent.

The modern medical application of cooling dates to James Currie (75) who in 1797 used cold sea water baths to treat patients with typhoid fever. He did this without having a useful clinical thermometer and it is likely that he did not achieve a true hypothermia, that is, a subnormal temperature, though body temperature was doubtless lowered. Except for this effort and the trials reported by Arnott in 1855 (31), nothing much was done clinically with general hypothermia until Fay (93) and Smith (265, 267) reported in 1940 on their use of hypothermia for the treatment of widespread cancer. The flurry of interest soon died out, for the treatment was ineffective. Interest in regional hypothermia was also awakened in the 1940's by Allen (3, 4) and other investigators who advocated it for anesthesia and preservation of tissue in gangrenous or damaged extremities, but this technique, too, found no permanent place and by the late 1940's hypothermia seemed to have no use in clinical medicine.

McQuiston gave new life to the use of cold when he advocated mild cooling during operation on infants with cyanotic heart disease (187), but the big stimulus which is still sustained was provided by Bigelow (32, 33) and Boerema (42), who described independently in 1950 the experimental use of moderate general hypothermia and temporary interruption of the circulation for open heart surgery. Many investigators have entered the field since then.

In this review, I hope to summarize the contributions of these many investigators and describe current knowledge and opinion under several sections: physiology, technique, clinical

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application, profound hypothermia, freezing, and prolonged hypothermia. The references provided should help anyone who wants to look further into the field; although by no means inclusive, the list contains many of the articles that have been helpful to me in my study of this subject.

Physiology and Pathology of Hypothermia

Hypothermia achieved under sufficient anesthesia to prevent shivering has a depressive effect on body functions which is a logical consequence of the slowed rate of chemical reaction. Yet the effect has not always been clear. An animal cooled without anesthesia, for example, will shiver and its general metabolic rate will actually increase for awhile even though the body temperature drops. If the animal is anesthetized to ablate shivering, however, the metabolic rate drops from the beginning of cooling (34). The depressive effect of hypothermia is not immediately evident in all functions of the various body systems. The heart appears to be more irritable, or at least more sensitive to the development of arrhythmia, as temperature falls, but this may actually be the result of a depressive rather than a stimulating effect. A similar appearance of increased excitability or hyperresponsiveness may be seen in nerve conduction. These problems will be discussed in the sections devoted to specific organ systems. The general effect of hypothermia is clearly depressive but the slowdown may not be parallel for all functions and an ideal balance among various enzymatic or physiochemical systems probably does not occur during cooling of the homothermic animal. For it hypothermia is an abnormal state which is dangerous if prolonged or if profound. The physiologic changes that occur are complex and not well understood; yet they may be tolerated for short periods of time without harm.

The fall of metabolic rate is clear-cut in the nonshivering animal. Directly related to temperature, the oxygen consumption of dogs falls to approximately 55 per cent of the basal metabolic rate at 28 degrees C. and to approximately 18 per cent at 18 degrees C. (34). With cooling to body temperatures near freezing, the oxygen consumption is too low for conventional measurement.

Concomitantly with the reduced temperature and oxygen consumption there is a fall in pulse and respiratory rate. The heart may continue to beat at temperatures as low as 2 to 5 degrees C., but more frequently cardiac standstill occurs at temperatures of 8 to 12 degrees C. if spontaneous ventricular fibrillation has not occurred (203, 204, 206, 207, 208). The respiratory rate in the anesthetized, nonshivering animal falls off more quickly than the heart rate so that respiratory arrest occurs in the homotherm at a higher temperature than cardiac standstill (143). Most studies of profound hypothermia have been made with the aid of artificial respiration, however, and the level of respiratory standstill for various animals has not been precisely determined. In any case, spontaneous respiration appears to be inadequate to prevent respiratory acidosis in the cold homothermic mammal.

The temperature gradients between regions of the body are apt to be greater during hypothermia than at normal temperature. The direction and size of the gradients depend, of course, on the method of cooling used and the length of time required to reach the low temperature. With relatively slow surface cooling, the skin and subcutaneous tissues are the coldest and gradients between various internal organs are not great. On the other hand, with a rapid method of blood cooling, the muscles and subcutaneous tissues remain relatively warm while organs with a large blood flow reach low temperatures quickly. These temperature gradients are important and hypothermia produced by surface cooling may result in physiologic changes quite different from those produced by hypothermia due to blood cooling.

Cardiovascular Physiology

Cardiovascular alterations due to hypothermia are crucial, for a type of circulatory failure is the commonest cause of death. Though ischemia is tolerated longer under hypothermia than at normal temperature, and even total circulatory standstill may be tolerated for more than 2 hours if the temperature is sufficiently low (5 degrees C.), inadequate tissue perfusion appears to be the most important failure during hypothermia. The relative intolerance of homothermic animals for prolonged or deep hypothermia is due to a weakness of the cardiovascular system, most evident in a propensity of the heart to ventricular fibrillation, but also evident in changes of the peripheral vessels. If the heart would continue to beat regularly at low temper-

atures, and if the peripheral circulation would remain patent, homothermic animals might withstand prolonged deep hypothermia as hibernators do. Understandably many investigators have directed their attention to the frailties of the cardiovascular system under hypothermia and especially to the tendency of the cold heart to fibrillate. Agreement exists concerning many of the cardiovascular alterations produced by hypothermia, but the basic mechanisms remain obscure.

Cardiac function and metabolism. The heart tends to fail during hypothermia either suddenly because of fibrillation or standstill or gradually because of diminishing strength. This failure does not regularly occur during a few hours of moderate hypothermia at levels between 25 and 30 degrees C. In fact, the heart may actually increase in efficiency (15), though there is some disagreement on this point (86), but failure does occur with more profound or prolonged hypothermia. The heart rate, blood pressure, and cardiac output all fall progressively as the temperature drops until with sufficient cooling the heart finally stops. If the stoppage is due to ventricular fibrillation this may happen at relatively high temperatures—perhaps between 20 and 25 degrees C. in dogs. If cooling can be carried to the point of standstill, this will occur at a much lower temperature, which in our studies (203, 206, 207, 208) was between 4 and 10 degrees C. in dogs, rats, monkeys, and man. Before complete standstill, the heart may beat only once every minute or two and if this very slow rate is not watched for, one may conclude that standstill has occurred at a much higher temperature than is actually the case.

As the heart slows and finally stops the electrocardiographic tracing shows impressive changes. The PR, QT, and QRS intervals are all lengthened and changes in the ST segment and the T wave soon occur. The elevation of the ST segment has been cited as evidence of cardiac anoxia (156) but Hoff and Geddes (140) point out that this may merely represent the ability of the heart to carry a continuous potential in balance from one cycle to another. Recovery is slow and there may not be time for complete electrical recovery. In man auricular fibrillation appears commonly at about 30 degrees C. At temperatures below 15 degrees C. atrioventricular dissociation with an idioventricular rhythm is usual.

At temperatures of 20 degrees C. or slightly higher, the heart appears to function quite well, at least for cooling of relatively short duration. Badeer (14, 15) while studying cardiac work during hypothermia found with work constant that cardiac efficiency rose. His studies, as well as those of Penrod (219) and Edwards and associates (86), show that the coronary arteriovenous oxygen difference remained normal, indicating that no cardiac hypoxia developed. Oxygenation of the heart muscle was apparently not impaired, even though the oxygen tension fell to as low as 4 or 5 mm. Hg because of the shift in the oxyhemoglobin dissociation curve produced by cold. A dissenting opinion concerning the heart's efficiency at low temperatures is that of Edwards (86), who found that the mechanical efficiency was reduced. Others, too, have demonstrated damaging effects of hypothermia on the heart (37, 169, 243) in studies which were unfortunately complicated by the addition of ischemia and a surgical incision. Circulatory interruption in these studies lasted for 8 minutes or longer and sometimes a ventriculotomy was added. In any case, Lombardo and his associates (169) demonstrated cardiac failure in their experiments and Sarajas, Senning, and Kaplan (243) found pathologic changes in the myocardium or pericardium in many cooled hearts. A somewhat different type of cardiac damage was described by Blair (37, 39), who found a posthypothermic failure. Certainly our work, and doubtless that of many other investigators, has shown an impressive, irreversible circulatory failure which may develop if hypothermia is prolonged and it becomes most evident during rewarming. Though moderate hypothermia of relatively short duration apparently does not injure the heart's function, prolonged hypothermia is definitely detrimental.

Several good studies of the coronary circulation have been made, among which are those of Berne (26, 27), Edwards (86), and Sabiston (242). The coronary flow decreases with cooling because of decreased cardiac output, a fall in mean arterial pressure, a decreased heart rate, increased blood viscosity, and a relative lengthening of the ventricular systole. Tending, on the other hand, to increase coronary flow is a reduced coronary arterial resistance resulting from the cold. The relative fraction of the total cardiac output going through the coronary bed

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is actually increased during hypothermia. If the heart rate is artificially increased during hypothermia by atrial stimulation, the coronary blood flow is drastically reduced because the diastolic period is shortened. Epinephrine will increase coronary blood flow but it is apt to cause ventricular fibrillation. Nothing in this work on coronary flow explains why the heart seems to be the weak link during hypothermia, why the general circulation may fail, or why cardiac standstill or fibrillation occurs at low temperatures. The most significant changes may be at the level of cellular function.

Vulnerability to ventricular fibrillation. A troublesome, often dangerous, limitation to the clinical use of hypothermia is ventricular fibrillation. Noted by all investigators, the onset of this arrhythmia has often been a terminal event in experimental hypothermia. It rarely occurs spontaneously in the dog cooled with a closed chest to temperatures between 25 and 30 degrees C., but it occurs frequently at temperatures below 20 degrees C., and if the heart is traumatized, as with a ventriculotomy, fibrillation may occur at temperatures between 28 and 30 degrees C. The moment of its occurrence is unpredictable though occasionally it may be heralded by ventricular tachycardia or frequent ventricular extrasystoles. Although it occurs frequently in the cold dog, it does not occur in the cooled rat nor in the hamster and these animals may be cooled to cardiac standstill without fibrillation. Occasionally and inexplicably the heart of a dog or of a human will behave in this manner too. Once fibrillation occurs, electrical defibrillation is usually required to restore a regular beat. This is not always the case, however, for if the heart is cooled further to complete standstill and then rewarmed an organized beat may occur in the cold heart.

Regular cardiac activity is normally maintained by a fine balance of excitability and conduction. Thus if cooling produces a nonsynchronous alteration in the various properties of the cardiac muscle, there could result a disorganization culminating in fibrillation. In outline such a pattern seems to provide a reasonable explanation though details are not clear. Several possible, relatively detailed, explanations of the increased vulnerability of the cold heart to fibrillation have been considered by Hoffman (131) and Hegnauer and Angelakos (125). The likelihood that ventricular pacemakers or separate pacemakers in the Purkinje fibers initiate ectopic ventricular activity to set off fibrillation seems improbable. Also dismissed as a potential mechanism is the persistence of an area of depolarization in the ventricle, though the cooled heart might fire repeatedly in the presence of an area of persistent depolarization. A third possible predisposing factor dismissed by Hoffman is the disorganization of the spread of electrical activity because of different electrophysiologic properties of the ventricular muscle and the Purkinje fibers. Actually, low temperature appears to affect the repolarization of ventricular muscle and Purkinje's fibers in a similar way so that the conduction velocity changes in both to a similar extent.

After eliminating these possible causes, Hoffman points out that the changes in electrical activity caused by cooling predispose to multiple firing, local blocks, or re-entry. In hypothermia transmembrane potential changes slowly during repolarization, thus leaving the membrane potential close to the threshold potential for a considerable period of time. Repetitive firing may then take place, resulting in action potentials which may fail to enter the specialized conduction system and set off ventricular fibrillation instead. Clarification of all this, Hoffman states, may well come from studies of the electrical activity of single fibers of muscle and the conduction system in situ (290).

Methods of preventing ventricular fibrillation. Since clear knowledge of the cause of ventricular fibrillation is lacking, efforts to prevent it have been empirical and not completely satisfactory. Still there are two obvious practical measures which may be taken to lower the incidence of ventricular fibrillation. The clinician, finding that fibrillation in man is not likely to occur if the temperature is kept above 30 to 32 degrees C., can avoid the complication by simply using less hypothermia. Phibbs and his associates (221) have given a quantitative description of the propensity to ventricular fibrillation at various depths of cooling. Using Shumway's (254) modification of Wiggers' (292) technique, they showed that a progressively weaker electrical stimulation is adequate to induce fibrillation as the temperature falls. Fibrillation occurred almost spontaneously at temperatures of about 23 degrees C. In contrast, temperatures above normal decreased the vulnerability of the heart to electrically induced fibrillation.

As a second practical precaution, the investigator may avoid heart trauma. Whereas a ventriculotomy may induce fibrillation at 32 degrees C. or even at normal temperature in the dog, the unmolested heart rarely fibrillates above 20 to 23 degrees C. Surgeons using hypothermia for cardiac surgery have learned to proceed with caution if they wish to avoid fibrillation. An extrasystole is a signal to desist from cardiac manipulation and an incision in the ventricle is to be avoided if an atriotomy will do as well.

Correct respiratory control may reduce the propensity to ventricular fibrillation. There has been some disagreement on this point (79, 285), but my associates and I have concluded that it is best to avoid respiratory alkalosis as well as any shifts in p_H (162, 163). In our experience, automatic respiration with a mixture of 5 per cent carbon dioxide in 95 per cent oxygen keeps the blood p_H at a relatively constant level and reduces the incidence of spontaneous arrhythmias and fibrillation. In fact, we have found it impossible to successfully cool and revive animals from profound hypothermia, that is, below 10 degrees C., unless carbon dioxide is used. Respiratory changes in blood p_H can, of course, be avoided by merely changing the rate of automatic respiration as the animal is cooled, and other investigators have used this system (197). Dependence on spontaneous respiration is uncertain in the cold homotherm and will lead to respiratory acidosis.

Several investigators have tested drugs which may alter the hypothermic heart's sensitivity to ventricular fibrillation. Though the results of these tests have not always been clear-cut, they have shown that a few drugs do decrease the sensitivity to fibrillation. The experiments have been of two types. In one the animal has been cooled without surgical intervention until fibrillation has occurred and the effects of the drug in altering the fibrillation temperature have been measured. In the other a ventriculotomy has been performed on the cold heart and the incidence of fibrillation after this trauma has been compared in test and control groups. Neither type of experiment is altogether satisfactory. For example, the gentleness with which the heart is handled will influence the incidence of fibrillation in the ventriculotomy experiment and matters such as the adequacy of respiration and the type of anesthesia can influence results in either type of experiment. In projecting the results of these experiments to clinical application another possible difficulty would have to be considered, for the dose of a drug which is sufficient to suppress the tendency to fibrillation may adversely affect the heart in other ways. Some of the drugs may bring about a type of acute heart failure.

Of the well known cardiac drugs, only quinidine exerts significant protective action against hypothermic ventricular fibrillation (11, 140). Digitalis apparently does not protect and the action of procaine amide is questionable. It has been described as having a protective action (122), no protective action (71, 184), or either a protective action or no protective action depending upon the circumstances (11). Angelakos, in a good review of the general subject (11), mentions screening tests that were carried out on a number of antimalarial, antihistaminic, local anesthetic, and antiarrhythmic drugs; only a few of these drugs proved to be effective. The antiarrhythmic drug, ambonestyl, previously described by Covino and Hegnauer (70) as being effective in protecting against surgically induced ventricular fibrillation, was about as effective as procaine amide but less effective than quinidine. Among the antihistaminics, antazoline proved to be the most effective drug and it may have practical usefulness, for it appeared to be better than quinidine.

Among other drugs, prostigmine has proved to be useful (195, 234) when injected into the ascending aorta to achieve high concentration in the coronary circulation. Swan has used prostigmine in this way to reduce the incidence of fibrillation during heart surgery performed under hypothermia. Another injection technique has been advocated by Riberi and his associates (233), who inject procaine into the sinoatrial node to decrease the heart's sensitivity to ventricular fibrillation. Arfonad has been described as effective by Riley and associates (234), and Covino and associates (71) found that a drug called dacorene was effective. None of the drugs yet tested appears to be ideal, but the new drug, antazoline, and the old one, quinidine, are probably the best. Even these have found little practical use. Confident that electrical defibrillation will work during rewarming, surgeons currently employing extracorporeal circulation and hypothermia for open heart surgery accept ventricular fibrillation.

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Small vessels. Changes due to cooling that occur in the small vessels may be the cause of most of the unfavorable effects of hypothermia, for an excessive vascular constriction or an asynchrony in vascular tone between organs or regions could explain many of them. Mechanisms which are not all clear as yet could lead to inadequate tissue oxygenation and even to the lowered plasma volume which is characteristic of hypothermia. Peripheral vascular resistance increases as the temperature falls (53, 126, 180) and this increase may actually be greater in the pulmonary vascular circuit than in the systemic circuit (152), thus placing a greater work load on the right side of the heart than on the left side during hypothermia. Among factors to be considered which cause increased resistance, the most important is probably the increased viscosity of the blood which takes place. This increase can be observed in vitro, but it is even greater in vivo because of the rising hematocrit which develops during hypothermia.

Constriction of the small vessels is also an important cause of increased vascular resistance. This small vessel constriction may not occur equally in all parts of the body, however, thus causing what Bullard (53) has described as changes in "vascular geometry." Furthermore, the small arteries and veins may fail to constrict and relax simultaneously. Haddy and his associates, while studying small vessel responses in the dog's foreleg, found that venous constriction persisted longer than arterial constriction during rewarming (120, 121). Thus, capillary pressure might exceed osmotic pressure, particularly during rewarming, resulting in an extravascular fluid loss and the increased hematocrit characteristic of hypothermia.

Still another change in the small vessels which may help to cause increased vascular resistance and inadequate circulation is intravascular agglutination or blood "sludging" (105, 168). In the small vessels where this is noted circulation may actually stop during hypothermia. This phenomenon has been noted in many conditions and it may not always be detrimental even in hypothermia. Nonetheless, the Swedish authors who have recently been interested in this phenomenon have decided that it should be treated and they find that it can be reduced by the intravenous administration of low molecular weight dextran.

BLOOD CELLS

Hypothermia produces an increase in the concentration of the red cells which, though reversible, is of consequence during hypothermia. The hematocrit invariably goes up and may reach levels as high as 68 per cent during prolonged cooling in dogs. This rise results in an increased blood viscosity, discussed in the previous section, which doubtless has a detrimental effect on the peripheral circulation. There is a clear sequence: loss of plasma, rise in hematocrit, increase in viscosity, and increase in peripheral vascular resistance.

In contrast to the increased concentration of red cells, there is a striking decrease in the number of white cells and platelets in the peripheral blood (127, 284, 289, 294). This drop is greatest in platelets and though all white cells fall off in concentration, the decrease is relatively less in the lymphocytes (294). Villalobos and his associates (284) concluded that this loss of white cells and platelets was due to a temporary sequestration of these elements from the circulation and that a major part of the sequestration was into the liver and spleen. During rewarming there is a prompt return of the platelets and white cells and, as measured by radioactive tracer studies, at least 80 per cent of the platelets returning are those which were in the circulation before cooling.

An increased bleeding tendency during hypothermia is doubtless linked to the low platelet count (127, 294). In detailed test tube studies of clotting factors in man, however, Von Kaulla and Swan (286) found that clotting was as complete at 28 degrees C. as it was at 37 degrees C. They concluded that bleeding episodes may be due primarily to an increase in thrombin inhibitor and that a tendency to hypercoagulability may develop during hypothermia. This brings up the possibility of intravascular clotting. Ellis and associates (90), too, in an earlier study of clotting factors, concluded that a drop in prothrombin, fibrinogen, and other factors was due to intravascular clotting. They attributed the bleeding tendency to the fall in these factors and found that the fall was less if heparin had been administered. Further confirmation of this paradoxic use of heparin is found in the work of Wensel and Bigelow (289), who also emphasized the importance of thrombocytopenia as a cause of hypothermic bleeding and noted that the thrombocytopenia was less both in dogs and man

when heparin was given prior to cooling. Thus it is possible that thrombocytes and perhaps some of the clotting factors are decreased during hypothermia because of intravascular clotting. This concept places the matter in a new light but it may not wholly explain the apparent sequestration and return of platelets described earlier by Villalobos and his associates (284).

Another change in the formed elements of the blood which is related to hypothermia is the decreased suspension stability or "sludging" of the red cells described by Gelin and Löfström (105). It has been discussed in the previous section in relationship to its potential effect on peripheral vascular resistance.

BLOOD ELECTROLYTES AND BLOOD GASES—RESPIRATION

Confusion has resulted from efforts to evaluate the effect of hypothermia on blood electrolytes and acid-base regulation. A tabulation of available data concerning a particular electrolyte may show authorities describing an elevation, a depression, or no change. We find a surprising number of disagreements. Aside from erroneous conclusions due to insufficient data, most of the disagreements are probably due to variations in the technique used to produce and maintain hypothermia. Certainly, whether or not an artificial respirator was used has been a crucial feature of technique, particularly if blood gases and *p*H are under scrutiny. Also of importance are matters such as the depth of anesthesia, the degree of hypothermia, the duration of hypothermia, and whether or not circulatory interruption was used during hypothermia. The type of cooling, too, whether surface or blood cooling, can play a part. When the available data are inspected with these modifying features in mind the main effects of hypothermia on electrolytes and blood gases are shown in carbon dioxide, venous oxygen saturation, *p*H, and potassium. Changes in these measurements are either secondary to respiratory changes, as they may be during normothermia, or result from inadequate tissue perfusion. When due to inadequate tissue perfusion, they represent late, and often irreversible, changes of hypothermia which are similar to changes produced in other types of shock.

Changes in blood carbon dioxide content and *p*H are influenced greatly by respiration. The plasma carbon dioxide level will rise during hypothermia if no respirator is used or if an inadequate respirator is employed, whereas this level will fall if an efficient respirator administering oxygen is employed (162, 208). It is understandable then, that contradictory results have been reported (79, 100, 101). An elevation of carbon dioxide due to inadequate ventilation during hypothermia can cause a lowered *p*H—a respiratory acidosis. In contrast, hyperventilation during hypothermia produced by a respirator may, in hypothermia of short duration, lead to an elevated *p*H—a respiratory alkalosis. This effect may be quite striking with an efficient respirator in an animal given enough anesthesia to obliterate all shivering. Despite this possibility of producing a respiratory alkalosis in some circumstances, however, there is finally a tendency toward acidosis on a metabolic basis during hypothermia (79). In our studies we have seen this acidosis most clearly demonstrated in prolonged hypothermia of 20 hours' duration. The *p*H invariably falls as cooling continues. Fisher, too, (100) noted this acidosis in hypothermia of relatively long duration. It is probably due to an inadequate circulation resulting in inadequate tissue perfusion.

Further evidence of inadequate tissue perfusion is found in the low venous oxygen saturation which develops in hypothermia of long duration. Though the arterial oxygen saturation is high throughout, and the venous oxygen saturation is found to be higher than normal after 4 hours of cooling, the latter becomes abnormally low after 20 hours of cooling. Despite the lowered metabolic needs during hypothermia, even these needs are not met and an unusually large amount of oxygen is extracted from the blood.

Possibly linked to the inadequate blood flow through tissues, or to changes in *p*H, or both, are the changes in serum potassium noted during hypothermia. Several authors (102, 212, 270, 278) have described a fall. Others have found no change (100, 101, 180) whereas Bigelow (33) found a rise. It appears that potassium may change during hypothermia and in most situations it tends to fall. Changes in serum potassium may depend upon the depth and duration of hypothermia. In some experiments we (206) found that the potassium level dropped early in profound hypothermia but then rose as time passed. The rise occurring late and during rewarming seemed to be greater in animals breath-

ing oxygen than in those breathing a mixture of 5 per cent carbon dioxide in oxygen and the rise may have been related to the higher blood *p*H in the animals breathing 100 per cent oxygen. The meaning of the potassium changes is not clear in every instance but a rise may indicate cellular damage.

Because the potassium ion has a profound effect on heart action which could relate it to the cardiac arrhythmias and standstill that occur during hypothermia, some investigators have studied potassium balance and potassium levels in the heart muscle. Here again there has been disagreement. Spurr and Barlow (270) have found a progressive increase in the potassium content of left ventricular muscle which they attribute to intracellular accumulation of the ion. In contrast, Gollan's group (112) has found a decreased potassium content in the atrial muscle during hypothermia and Covino and Hegnauer (69), on the basis of coronary arteriovenous difference studies, concluded that the heart loses potassium. On the other hand, Swan and his associates (278) reported a positive myocardial balance. Some of this disagreement may be attributable to the type of ventilation used, for Montgomery, Prevedel, and Swan (195), studying coronary differences in potassium, showed that potassium accumulated in hypoventilated dogs while it remained in balance when respiratory alkalosis was produced. In any case, changes in potassium have not been sufficient to explain satisfactorily the cardiac arrhythmias and cardiac arrest that are a characteristic feature of hypothermia.

Apparently less influenced by hypothermia than carbon dioxide, *p*H, and potassium are blood levels of some of the other important blood chemicals. Sodium, for example, shows no significant change in most studies (79, 100, 101, 102, 278). Chloride, too, has shown little or no change (79, 100, 101, 278) and calcium (34, 100, 101, 102), magnesium (101, 102), phosphorus (100, 101, 102, 278), blood sugar (79, 100, 102), lactic acid (79, 100, 101), blood urea nitrogen (79), serum protein (159), and amino acids (100), have also shown no significant changes.

Hypothermia alters many other features of respiratory gas transfer (249). There is an increased solubility of gases as temperatures fall and the oxyhemoglobin dissociation curve shifts to the left. Application of the Henderson-Hesselbach formula is changed by an alteration in pK as temperature falls. Lung volumes are changed by an increased respiratory dead space. Nonetheless, gas exchange at the lungs is effective during hypothermia if artificial respiration is used so that the failure of adequate exchange at the tissue level during prolonged hypothermia is ultimately a failure in circulation rather than a failure of respiration.

LIVER

Hypothermia depresses the function of the liver, as it does other bodily functions, and it increases the liver's tolerance to ischemia. Studies on liver function, which have been carried out principally on isolated, perfused livers of the rat and rabbit (47, 48, 118), have shown a decreased metabolism, a depressed bile secretion, and a depressed ability to clear the blood of bromsulphalein and $CrPO_4$. In addition Brauer (47) found that splanchnic blood flow decreased more than cardiac output during hypothermia. There was no evidence, however, that resistance to blood flow through the liver increased during hypothermia more than could be accounted for by increased blood viscosity. A slight increase in liver volume during hypothermia was attributed to a shift of fluid into the intracellular compartment.

While studying the tolerance of the liver to ischemia Shumway and I (255) had some difficulty in assaying the effect of liver ischemia separately from neighborhood effects on other viscera incident to vascular occlusion of the liver. Sequestration of blood in the splanchnic area, for example, is difficult to prevent when the portal vein is occluded. Nevertheless, despite these difficulties, it appeared that hypothermia did increase the tolerance of the liver to ischemia and that the hypothermic canine liver would tolerate about an hour of complete vascular occlusion without irreversible damage whereas 20 minutes was about the tolerable limit at normal temperature (229).

KIDNEYS

Lowered renal metabolism has been demonstrated in reduced renal function and increased tolerance to vascular occlusion which will allow the cold kidney to suffer less renal impairment after 4 hours of arterial occlusion than is found after 2 hours at normothermia (43, 200). Most of the studies of the effect of hypothermia, without ischemia, on blood flow and renal function

have tended to confirm one another (7, 123, 190, 196, 198, 200, 201). Blood flow falls off as cardiac output and blood pressure decrease so that the renal flow has fallen to one-half normal at 30 degrees C. (211), while the vascular resistance increases and the maximal tubular excretory rate decreases. In Moyer's studies (201) the drop in glomerular filtration rate was accompanied by no significant alteration in urine volume or sodium excretion, whereas Andjus (7) found that the urine output was actually increased at temperatures between 20 and 23 degrees C. Studies at normal temperature have usually shown that urine volume and sodium excretion decreased if the glomerular filtration rate fell. Moyer attributed this paradoxic finding in hypothermia to a depression of tubular transport of sodium and water. Andjus, too, concluded that hypothermia inhibited the resorptive activity of the renal tubules which caused an increased urinary output. Morales and his associates (196) found, in support of some of the observations of Moyer, that sodium excretion was not appreciably altered during moderate hypothermia and that the reduction in urinary flow was not as great as the reduction of the glomerular filtration rate. Some disagreement is found, however, for Morales noted an increased excretion of potassium, whereas Moyer found that it was decreased.

Most of these measurements of renal function have been made at temperatures around 30 degrees C., though Andjus' studies were carried out at 20 degrees C. With further lowering of the temperature there is, finally, a profound suppression of urinary output as well as of all other renal functions.

ADRENALS

The function of the adrenals, too, is depressed by hypothermia but this had to be carefully studied, for it seemed possible that hypothermia might stimulate adrenal cortical secretion when one recalled that Selye and Schenker used exposure to cold to produce a stress response in rats (248). Later studies by Egdahl and Richards (88) demonstrated that the dog, also, would respond to sufficiently intense cold exposure by an increased output of adrenal corticosteroids. If the dog is anesthetized before it is cooled, however, adrenal function is depressed. This depression has been well shown by the studies of Egdahl, Nelson, and Hume (87) and by those of Ganong, Bernhard, and McMurrey (104) in work which Hume and Egdahl have recently summarized (137). Not only is the adrenocortical response to trauma depressed by hypothermia but also the response of the gland to ACTH infusion is depressed. Further, the blood level of ACTH is low during hypothermia, indicating that pituitary activity is reduced. Local cooling of the adrenal gland as well as general hypothermia has reduced corticosteroid output, suggesting that the effect of cold is a direct one rather than some sort of a secondary manifestation of general hypothermia. Epinephrine and norepinephrine output are decreased during hypothermia, too, thus showing that the medullary as well as the cortical function is depressed. Depression of adrenal function in the dog is first noticed when the temperature falls to about 34 or 35 degrees C. and as cooling continues the function decreases until the response is apparently absent at 23 degrees C. Cooling does not damage the gland, for there is an immediate return of responsiveness as the animal is rewarmed.

Despite this depression of adrenal secretion, the peripheral blood level of free 17-hydroxycorticosteroids remains normal (29). This probably means that depression of the liver's ability to conjugate corticosteroids is of the same magnitude as depression of adrenal function.

In a few studies of human adrenal secretion during hypothermia (136) it appeared that there was a depression of function similar to that noted in the dog.

NERVOUS SYSTEM

Throughout history cold has been applied to relieve pain in an effect which is caused by its ability to depress nerve conduction. Modern studies, summarized by Chatfield (59), have identified quite precisely the point at which the nerves in various animal species cease to conduct impulses. Mammalian nerves are blocked at higher temperatures than frog nerves, and the nerves of hibernators conduct impulses at lower temperatures than those of nonhibernators. In addition to these differences between species, there is a difference in susceptibility between various nerves of the same species, and in some species, such as the frog, there may actually be a seasonal variation. Complete block in homotherms usually requires a temperature of 10 degrees C. or lower whereas with only moderate cooling, approximately 25 degrees C., there is

actually a phase of hyperresponsiveness. This phase has been studied by McBrooks and his associates (151) who have concluded that it is not due to an increase in excitability but rather to (1) repetitive discharge, (2) a greater participation of interneurons in reflex action, and (3) a greater power of recruitment at synaptic junctions.

The effect of hypothermia on the central nervous system is also depressive, and similar to its effect on other organs (25, 145, 171, 186, 240, 271, 272). Cerebral metabolism is reduced at a rate measured by Rosomoff and his associates (239, 240) as 6.7 per cent per degree centigrade. Blood pressure drops at a slightly slower rate and cerebral vascular resistance increases. Blood flow decreases and brain activity, as indicated by the electroencephalogram, falls off in a striking manner. Brain volume is reduced so that at 25 degrees C. the brain size has decreased 4.1 per cent while the extracerebral space has increased 31.8 per cent and with this the cerebrospinal fluid pressure is reduced.

The depressive effect of hypothermia on brain function allows the brain to tolerate anoxia better than it does at normal temperatures. In studies of the monkey, an animal which is more suitable than the dog for this type of investigation, McMurrey's group (186) found that 15 minutes of cerebrovascular occlusion, produced by vascular occlusion within the chest, could be tolerated when the temperature was 23 to 26 degrees C. Hypothermia also protected against the brain damage caused by permanent interruption of the middle cerebral artery in dogs (235, 236) and the effect of a standard injury was less when the brain was cold than when a similar injury was produced at normal temperature (237). The obvious practical implications of these studies will be discussed in a later section.

Techniques of Cooling and Rewarming

Cooling

Surface cooling. Surface cooling has been the simplest, safest, and most widely used method of achieving total body hypothermia. It was the method used by Fay (93), who immersed his patients in cracked ice, and subsequently it has been used at one time or another by many investigators and clinicians who may have employed special cooling blankets rather than an ice bath. The tendency to shiver is great with surface cooling and, hence, relatively deep anesthesia has usually been employed, though recently Mellinger (188) has stated that this was unnecessary. There is a considerable temperature gradient between the superficial and deep tissues which is inefficient in direction, for the vital organs that need hypothermic protection are not cooled as intensely as are the skin and superficial muscles. After cooling has been stopped, a downward drift in body temperature occurs and the extent of this drift is sometimes difficult to predict. Opposed to these disadvantages, surface cooling has the advantage of being unencumbered by elaborate equipment or techniques.

Supplements to surface cooling. Perhaps the best known variation of surface cooling has been the "artificial hibernation" of Laborit (153, 154) in which a number of drugs are used to supplement cooling. The drugs have been chosen because of their ability to produce autonomic blockade. Dundee (84) has pointed out that of the three main drugs employed in the "lytic cocktail" used for "artificial hibernation" (chlorpromazine, pethidine, and promethazine), chlorpromazine is the only one that helps to lower the body temperature. This drug reduces shivering but this is an effect that can also be achieved with conventional anesthesia or curarization. In further analysis of the "lytic cocktail" Dundee found that the effect of hypothermia on oxygen intake, pulse rate, and respiratory rate was the same irrespective of how the hypothermia was achieved—whether by deep anesthesia, curarization, or the "lytic cocktail." A chemical method of lowering the metabolic rate would be of great value, but a chemical substitute for hypothermia is not yet known.

Another method of supplementing surface cooling has been the addition of coronary artery perfusion during open heart surgery performed with surface cooling. When the desirable temperature has been achieved with surface cooling, and during the time that the circulation is interrupted by caval occlusion, the ascending aorta proximal to a clamp is perfused with blood which passes immediately into the coronary arteries. Thus, the heart, which is a vulnerable organ during inflow occlusion for open heart surgery, is nourished with perfused blood while normal flow through its chambers is absent. This technique has extended the safe period of open cardiotomy during hypothermia. When we first recommended this supplementation to surface

cooling (253) we used a small oxygenator for the perfusion, but subsequently the technique has been simplified and it has been used successfully for certain types of open heart surgery (80, 147, 182, 268, 269).

Boerema (41), ingeniously, has supplemented surface cooling with high atmospheric pressure. As atmospheric pressure is increased, the blood carries more oxygen in physical solution so that at 3 atmospheres of pressure, the amount in physical solution is probably 15 times that at normal atmospheric pressure. This oxygen in solution is immediately available to the tissues and independent of the adverse shift in the oxyhemoglobin dissociation curve which occurs during hypothermia. An animal breathing oxygen at increased atmospheric pressure during hypothermia does not need hemoglobin. Further, the increased amount of oxygen held in physical solution in all tissues of the body may act as a reserve which can be utilized while the circulation is arrested. With these concepts in mind, Boerema has cooled and operated upon rabbits under 3 atmospheres of pressure. The surgeons, who were also in the pressure tank, breathed air while the rabbit received oxygen. Using only moderate cooling, 27 degrees C., he found that the cavae could be occluded for as long as 45 minutes with recovery. This is an impressive extension of the tolerable occlusion time which is about 15 minutes at 1 atmosphere of pressure. High atmospheric pressure during hypothermia has not yet been taken up by others or applied clinically, no doubt because of the technical difficulties of working under high pressure.

Organ cooling. Local cooling has been applied to a number of organs, usually with the purpose of lowering the metabolic rate of an organ selectively so that it alone could withstand ischemia better. Because of the heart's sensitivity to anoxia and because breakdown of its function is so obviously catastrophic, local cooling of the heart has been useful and it has generally replaced potassium as a means of achieving cardiac arrest during open heart surgery. With inflow and outflow of the heart interrupted it is easy to lower the heart's temperature to 10 degrees C. or lower by simply filling the pericardium with cold saline (256) or by the more complex technique of perfusing the coronary arteries with cold blood (30, 115). In either case, the heart will withstand a long period of arrest without apparent damage. Shumway found that 1 hour of cardiac anoxia was tolerable—a fact that he and his associates have demonstrated dramatically in canine, total heart transplants (174).

Of course when the heart is cooled a supporting system of extracorporeal circulation is required for the remainder of the body. Other applications of organ cooling have been designed with sort of a reverse of this idea. They demand good heart function while the metabolic rate is slowed in other areas. The heart is allowed to remain at near normal temperature and the organ to be subjected to anoxia for surgical convenience is cooled selectively.

Selective brain cooling has been undertaken as a potential aid both in neurosurgery and open cardiac surgery but, as yet, little practical application has been found for either. Though attempts have been made to cool the brain by simple cold application to the head (77), vascular cannulation and blood cooling are probably required. Some have tried to achieve relatively complete vascular isolation of the head by employing both arterial and venous cannulation (181, 296) whereas others (150, 171) have cannulated only the carotid artery, taking blood from the proximal artery and then running it through a cooling coil before pumping it into the distal artery. The first system in which the head is isolated requires a pump-oxygenator in the circuit; the second system, though not quite as complex, still needs a pump. Even though rectal temperatures drop only slowly with this second system, the heart is doubtless cooled quite rapidly as cold venous blood flows back directly to it and this may account for the cardiac arrhythmias which were so common in Lougheed's (171) use of selective brain cooling. Surface body cooling is probably used today in most cases in which hypothermia is needed for neurosurgery.

General rather than local hypothermia has been used in most cases in which cooling has been employed to protect the kidney against temporary ischemia, but there is an effective technique that achieves local renal cooling which may be valuable for renovascular surgery of the type now employed in the treatment of some cases of renal hypertension. The kidney is enclosed in a double plastic bag (244) or a special heat exchanger (62) and cooled rapidly. A further application of local renal cooling which may be needed for homografting is that of

maintaining a viable organ by perfusion plus hypothermia (68). Some technique such as this will become necessary for the preservation of organs awaiting their use as surgical homografts.

Gastric cooling has been used either as a technique to attain general hypothermia (18, 132, 149) or for its local suppressive effects to stop gastric hemorrhage (287, 288). The technique of gastric cooling is much the same in either application. A cold irrigating solution is pumped through an intragastric balloon or the cold solution is pumped directly into the stomach through a small tube and allowed to run out through another slightly larger tube. We have used both systems and currently employ an intragastric balloon. With either irrigating technique, the external cooling and pumping system must be designed so that an excessive amount of fluid is not pumped into the stomach. Gastric cooling effectively speeds up both induction of hypothermia and rewarming when used with surface cooling and rewarming. Since it cools centrally it is efficient and it achieves cooling with less shivering than is seen with surface cooling alone.

Intrapleural cooling has been used to achieve general hypothermia by simply pouring cold saline into the open chest cavity during a cardiac operation (36). This method may be faster than surface cooling but there is probably a risk of infection, and the cooling is still much slower than that obtained by blood cooling.

Regional cooling of the extremities. Regional cooling was a popular technique a few years ago to reduce the metabolic rate of gangrenous or injured extremities (3, 4, 74). Prior to 1945, the literature on this subject is voluminous. In some cases surgeons hoped that a badly damaged extremity might be saved from amputation, but in most cases regional hypothermia was used only to reduce the toxemia caused by gangrene and to provide anesthesia for amputation. This technique of cooling seemed to lose popularity as antibiotics appeared; they provided a sounder and easier way of dealing with infection.

Blood cooling. Blood cooling is a currently popular and rapid technique which will lower the central body temperature to below 30 degrees C. in a few minutes and below 10 degrees C. in 20 minutes to an hour. Cooling in various parts of the body is not uniform. The organs which have a rapid metabolic turnover and a high blood flow are cooled first so that profound cooling is attained in the brain, heart, and liver while the skin, subcutaneous tissues, and muscles still remain relatively warm. This temperature gradient is generally an advantage because the organs most sensitive to oxygen lack are cooled first but it can be misleading and there are advantages in having the entire body cold if the total circulation is to be stopped.

Blood cooling is achieved most simply by shunting blood from an artery to a vein through a coil which is immersed in ice water (42) or by pumping blood from one vena cava to the other with a single pump in the circuit (50). In more common use, however, are blood cooling techniques which form part of a pump-oxygenator system. This combination is probably the most popular way of doing open heart surgery today. The blood is cooled by cooling part of the oxygenator itself (282, 300) or by pumping the blood through a special heat exchanger as it leaves the oxygenator. Gollan and his associates (109, 110, 111, 113) studied this technique experimentally for a number of years and by using a small bubble oxygenator containing a metal coil which cooled the blood they were able to reduce the temperature of dogs to near freezing with recovery. Impetus in applying this technique to open heart surgery was provided by the work of Sealy and Brown and their associates (245), who use a heat exchanger consisting of multiple stainless steel blood tubes arranged in parallel and encased in a jacket through which the cooling fluid is pumped (51). With this system, patients undergoing open heart surgery have been cooled to below 10 degrees C. successfully.

Another technique of extracorporeal circulation and blood cooling eliminates the oxygenator by using the patient's lungs, two pumps, and a heat exchanger (82, 83, 250). Through a catheter in the right atrium, blood drains into a reservoir from which it is pumped into the pulmonary artery. Similarly, a catheter in the left atrium drains blood into a second reservoir and this blood is pumped through a heat exchanger back into the systemic circulation by way of the femoral artery. Central body temperature may be lowered quickly to 20 degrees C. and at this low temperature circulation may be stopped for 30 minutes or longer while an intracardiac repair is performed. The system needs much less blood than an oxygenator and we employ it now for a number of types of open heart surgery.

REWARMING TECHNIQUES

To rewarm after general hypothermia a simple reversal of the cooling technique is usually adequate. Warm blankets will rewarm a patient if cold ones have cooled him; blood can be rewarmed with the same heat exchanger that cooled it. Some special techniques have been advocated for rewarming, however. Blair, Swan, and Virtue used diathermy (38) and dialectric heating has been employed by Lovelock and Smith to rewarm cold animals (173). I have not had experience with dialectric rewarming, but diathermy, in our hands, was apt to cause burns. Still another special rewarming medium, advocated by Boerema, is hot air (41). After cooling and while the chest is still open, the patient remains in a closed cabinet under observation while warm air blows over him.

Clinical Applications of Hypothermia

CARDIAC SURGERY

Clinical application in cardiac surgery has been responsible more than any other application for an intense study of hypothermia during the past decade. Hypothermia was first used only tentatively in mild degree as a supplement to anesthesia but later, by providing a simple technique for carrying out short, open heart operations, it gave a great stimulus to heart surgery. Later, as extracorporeal circulation for open heart surgery became practical, hypothermia assumed the role of a supplementary technique, and it is here that it finds its most popular use in cardiac surgery today.

The introductory steps were taken by McQuiston and Potts (187, 228), who found that children with cyanotic heart disease tolerated surgical intervention better if their temperature was slightly below normal than if it were allowed to become elevated. This work, important in its own right, was introductory to the more significant application of hypothermia in which the circulation is stopped to allow an open intracardiac operation. A bloodless cardiotomy could be carried out even at normal temperatures with inflow occlusion, but only with hypothermia was there enough time to make the method useful.

Bigelow (32, 33) and Boerema (42) demonstrated the feasibility of this method experimentally; later, we were successful in repairing an atrial septal defect in man (166) and soon others were using the technique (16, 277, 278). For a while it was used by many. In the experimental work and some of the earlier clinical cases the body temperature was lowered to 25 degrees C. or lower, thus permitting 15 to 20 minutes of cardiac inflow occlusion, but this degree of cooling proved to be dangerous chiefly because of the frequent occurrence of ventricular fibrillation. The best method to lower the incidence of this complication was simply to use a higher body temperature; surgeons soon learned to employ temperatures of 28 to 32 degrees C. With this depth of hypothermia cardiac inflow was tolerated safely for 6 to 8 minutes—long enough to correct a few uncomplicated intracardiac defects.

This method of performing open heart surgery has been used almost exclusively for the repair of atrial septal defects of the foramen ovale and high types and for correction of pulmonary stenosis with a normal outflow tract. Results have been good and hypothermia may continue to find employment in this manner for these relatively simple defects. My associates and I reported on the repair of 63 atrial septal defects with this technique a few years ago (167). Follow-up studies indicated that the repair had been complete and lasting in most instances. Swan and his colleagues have had results as good or better (276) and many surgeons have used hypothermia in this way to repair atrial septal defects.

Swan (274) developed the operation for relieving pulmonary stenosis with a normal outflow tract, that is, isolated pulmonary stenosis, and demonstrated that it achieved a more complete relief of obstruction than had been possible with the blind transventricular operations. In a similar fashion Swan and Kortz (275) and Lewis (165) have used hypothermia to perform open operations on the aortic valve. This simple method of performing open aortic valve surgery achieved its best results in cases of congenital aortic stenosis, a type of disease in which there is little or no valve calcification. The technique helped to get open surgery of the aortic valve started, but it has been replaced by extracorporeal circulation.

A few other types of cardiac surgery have been performed with simple hypothermia, but extracorporeal circulation is now used for most open heart surgery. Since Gibbon (107) first used a pump-oxygenator to take over the circulation of cats, surgeons have expected that these

machines would provide the best method for open heart surgery. Hypothermia appeared only when the development of pump-oxygenators seemed to be slow. When the machines came on the scene in numbers, hypothermia took a new role, supplementing extracorporeal circulation.

A preliminary method of combining hypothermia and blood perfusion was the relatively simple one of adding corónary artery perfusion to simple hypothermia. This method is described in the section on techniques. It became a useful technique for repairing atrial septal defects in the hands of some surgeons (182, 253, 268) and it has also been used to repair ventricular septal defects (119).

Today, a pump-oxygenator plus blood cooling is by far the most frequently used combination. With various degrees of cooling this system has been used for all types of open intracardiac surgery and it probably represents the commonest way of performing open heart surgery at the present. Temperatures even below 10 degrees C. have been used for a number of intracardiac operations.

Still another combination of perfusion and cooling, also described under the section on techniques, is autogenous oxygenation plus hypothermia (82, 83, 250). Since the atrial chambers are used for blood collection with this technique perfusion cannot continue when the surgeon enters these chambers. Operations on the mitral valve or the atrial septum, for example, can not be carried out unless the blood flow is temporarily stopped. Thus, this technique requires sufficient hypothermia to allow circulatory interruption for some types of intracardiac repair. With body temperatures at 20 degrees C. or lower the circulation may be stopped for 30 minutes, and at temperatures below 10 degrees C. a longer occlusion period is possible. The aortic and pulmonary valves may be exposed while pumping continues by use of a special clamp to separate the atria from the ventricles (133). This system for open heart surgery has not yet been tested as extensively as have pump-oxygenators and we can not tell yet if it will find a lasting place in cardiac surgery (35, 114).

Nonetheless, hypothermia in some form will doubtless continue to have a place in cardiac surgery. The general slowing up of physiologic processes achieved with hypothermia is attractive and deep hypothermia would still seem to provide the only way yet devised of eliminating the complex and somewhat dangerous machinery that presently supports an open heart operation.

GENERAL SURGERY

Although surgeons have been advised to utilize hypothermia for many types of major surgery, they have not done so. The place of hypothermia in general surgery remains uncertain. If it can be made safer and easier to administer, it may find wide application, but at the present time its use in general surgery is sound only for some patients with a tendency to fever in whom cooling to a normal temperature is sufficient, for some patients with liver disease, for some patients in whom long regional vascular occlusion is helpful, and for some patients suffering from gastric hemorrhage.

Poor risk patients. Cooling during anesthesia may help some poor risk patients, but certainly not all, and the indications are unclear. Hypothermia is probably not useful for old people, nor for infants undergoing major surgery, nor is it indicated for patients undergoing major operations in the mild degree called "artificial hibernation" (153, 154). It may be worth while, nonetheless, in special situations, such as for patients with cirrhosis and poor liver function who are subjected to portacaval shunt operations (28, 157, 227). Mild body cooling sufficient to prevent fever is indicated for children in whom fever may develop during long operations and for infants and children undergoing heart surgery for cyanotic heart disease, an application suggested by McQuiston 10 years ago (187) which is still one of the soundest uses of cooling.

Regional ischemia. Just as hypothermia makes total circulatory interruption feasible for open intracardiac surgery, it will allow prolonged regional or organ ischemia for other operations. The possibilities are attractive to the surgeon faced with the technical problems of complex operations in highly vascular areas. An operation in a bloodless field is strikingly easier and more precise than the same operation performed through a film or puddle of blood. Though orthopedic surgeons routinely achieve this bloodless field in surgery of the extremities at normothermia, prolonged ischemia has been too dangerous to use in other regions of the body. Hypothermia, by lowering the metabolic rate, changes the picture. An imaginative physician

will think of a number of possible applications. Uses in neurosurgery, which are most important, will be discussed in a later section.

In vascular surgery there have been a number of applications. During moderate hypothermia the descending thoracic aorta beyond the subclavian artery may be clamped for excision of an aneurysm without causing the spinal cord injury which would follow the same occlusion during normothermia (21, 89, 142, 214, 218, 223). Hypothermia prolongs the permissible period of aortic occlusion at this level to more than 30 minutes. This technique has a serious disadvantage, however, for as the aorta is clamped, a proximal hypertension develops which overloads the left ventricle. Since patients with aneurysm usually have some coronary artery disease, this additional load may cause acute heart failure. A safer technique for operating upon this portion of the thoracic aorta employs a pump which shunts blood from the left atrium to the distal aorta by way of a femoral artery (66, 78).

Hypothermia may be indicated in certain operations on the abdominal aorta. Occlusion below the renal arteries, the level at which it is usually required, is tolerated at normothermia for sufficient time to permit a graft replacement. On the other hand, occlusion of the renal arteries for longer than 30 or 45 minutes may be followed by renal failure. With moderate hypothermia, this permissible occlusion time is extended to an hour (72, 244). If the temperature of the kidney is reduced even further, longer periods of ischemia are tolerated. This deep cooling has already played a part in the homografting of kidneys, and selective organ cooling will doubtless be a part of future homografting techniques in which viable organs must be preserved during relatively long periods of ischemia.

The liver is another infradiaphragmatic organ exceptionally sensitive to ischemia. At normal temperature, even 20 minutes of vascular occlusion is dangerous, but with cooling an hour of vascular occlusion is safe (229). Thus, hypothermia should facilitate hepatic surgery, permitting resection in a bloodless field. We have used hypothermia with occlusion of the aorta, porta hepatis, and inferior vena cava to carry out right hepatectomy (255) and find that it is a satisfactory way to perform this formidable operation, but others have accomplished it, apparently as well, without hypothermia.

Occlusion of the aorta above the celiac and superior mesentery arteries produces a fairly complete ischemia of all the abdominal viscera, particularly those of the lower abdomen and pelvis. Thus, a large bloodless area is provided for the surgeon performing the extensive operations that may be required for malignant lesions of the viscera. With hypothermia, occlusion of the high abdominal aorta is tolerated for about an hour. I have employed hypothermia and aortic occlusion in this way, but not frequently enough to permit a sound evaluation of the technique. Burch and his colleagues have recommended it (55) and it deserves further trial.

Moving out on the vascular tree from the viscera to the extremities, we find that regional hypothermia enjoyed a vogue, prior to the antibiotic era, as treatment for gangrenous and infected extremities. This application, described in the section on techniques, was advocated principally by Allen and Crossman (3, 74); it preceded by a number of years the current interest in hypothermia and did much to direct attention to possible clinical uses of hypothermia. It is a treatment not widely employed at present. When infected gangrenous legs were cooled by this technique, the patient's toxicity was reduced and his general condition improved. Users of the technique had hoped that in some cases the extremity could be rewarmed later with improvement over its precooled state, but this rarely happened.

Gastric bleeding. Stomach cooling was first employed as a technique of cooling to achieve general hypothermia (18, 132, 149), but Wangensteen and his associates (287) extended its application to the treatment of certain types of gastric hemorrhage. The effect of intense local cooling on gastric function is profound, with a depression of acid and pepsin secretion as well as a vasoconstriction. The digestive activity of the organ ceases. Since continued bleeding from a peptic ulcer or from mucosal erosions is due in considerable degree to the irritant effect of acid-peptic digestion, cooling to reduce this activity is logical. There may be problems in cooling the whole organ, particularly if blood clots remain within it, but the method interests many surgeons and gastroenterologists and it is undergoing evaluation in a number of medical centers. Wangensteen maintains the general body temperature normal while cooling the stomach but recently general hypothermia has been recom-

mended for treating gastrointestinal hemorrhage (116).

Gastric cooling appears to have an effect on pancreatic function too, which may influence the course of experimental pancreatitis (202).

Burns. Some of the applications of cooling in general surgery which we have just described do not produce a general lowering of body temperature; the hypothermia is regional only, for there would be no reason to cool the entire body. In the treatment of burns, the question of whether or not general body cooling should be added to local cooling is not yet settled. Regional or surface cooling of the burned area appears to have a beneficial effect on the basis of a few recent studies (24, 232, 252). Local cooling applied shortly after the injury may reduce the secondary reaction to the burn and result in less ultimate tissue damage. It definitely reduces pain. General body hypothermia at least for a few hours may also be helpful (183, 232), but this application needs further study. In any case, prolonged hypothermia should probably not be used.

Shock. Though externally applied heat is undesirable in the treatment of hemorrhagic or traumatic shock (12, 40, 85) its converse, intentionally produced hypothermia, is probably not a good treatment either. Experimental studies have not all led to this conclusion and, indeed, some of them suggest that hypothermia may actually be helpful in experimental hemorrhagic shock particularly if the animals were pre-cooled (103, 213, 226) but other studies have shown no benefit from hypothermia (98, 144). The way in which shock is produced, whether by bleeding to a certain pressure or loss of a predetermined volume of blood, may be critical in such experiments. Impressive supplementary evidence that hypothermia is contraindicated in shock may be found in studies of prolonged hypothermia where it actually produces a type of shock (100, 161). If prolonged hypothermia produces shock, short term hypothermia can hardly be a reasonable treatment of shock.

Infection. To be an effective treatment for infection, cooling would need to depress bacterial activity more than it depresses the host's resistance to infection. In fact, it depresses both, and one to about the same degree as the other so that it will slow the progress of an infection but not aid in killing the infectious agent. Thus, it has limited value in the treatment of infections. The experimental studies that lead the reviewer to these conclusions have employed both regional (52) and general hypothermia (17, 96, 103, 299).

Fever. The immediately preceding sections on burns, shock, and infections, and this one on fever obviously overlap one another. A burned patient, for example, may suffer from shock, infection, and fever all at once. Thus the practical problem is often whether or not to lower the body temperature of a desperately ill patient. In my opinion, a high fever is a sound indication for taking such action.

Body cooling for patients with high fever has been used with varying enthusiasm for at least a century and a half, and doubtless much longer. Currie used cold sea water in 1798 for patients with typhoid fever (75) and subsequently many others have cooled feverish patients by various means. This is not, strictly speaking, hypothermia, if the temperature is only brought down to normal, but sometimes true hypothermia is used, and in any case, the physiologic effect of reducing temperature is similar whether the starting point is normal or high. In recent decades, surface cooling for fever has been accepted for the high fevers of heat stroke (13), approved by many physicians for the fevers caused by injury of the central nervous system, and advocated by some as a treatment for high fevers due to any cause. Not all have agreed that cooling is valuable, and even an enthusiast must admit that clinical evaluation has been difficult.

My associates and I (160, 164, 231) have joined others (81, 128, 139, 141) who in recent years have advocated body cooling for some patients with high fevers. Though a fever is probably never beneficial, cooling is not necessary for most patients with fever. Occasionally, however, the increased metabolic rate, manifested by a rapid pulse and a fast, labored respiratory rate, is exhausting and unless the temperature is lowered promptly the patient may succumb. For these patients an effective method which reduces the temperature and keeps it down is beneficial.

After some experience with a technique of surface cooling, we tried to undertake a controlled evaluation (231) in which the test and control groups were selected patients with high fevers who appeared terminally ill. The only survivors were among those who had been cooled. Though others seemed to have benefited, the best results were obtained in patients whose high fever was due to injury of the central nervous system.

NEUROSURGERY

In several of the clinical [illegible] previously been discussed [illegible] fective because it increased [illegible] nervous system to ischemia. [illegible] for surgical intervention whic[illegible] sion of the thoracic aorta beca[illegible] tolerance of the spinal cord to [illegible] ischemia of vascular occlusion. In cardiac surgery the brain is the sensitive organ which needs protection by hypothermia. It is a logical extension of these applications to use hypothermia for direct procedures on the nervous system itself. In a highly vascular and sensitive region like this, where hemostasis may be trying, the idea of temporarily occluding the major blood supply has sound appeal. This concept has been applied experimentally and clinically by a number of neurosurgeons, and with it direct operations on vascular anomalies, previously associated with a prohibitive risk, have been possible. Lougheed and Botterell (44, 45, 170, 171, 172) in particular have been advocates of this method, but it has had the endorsement of others (1, 175, 225) and its use represents a significant advance in the treatment of intracranial vascular malformations. With moderate levels of hypothermia, 28 to 30 degrees C., achieved by surface cooling brain circulation may be interrupted for 10 to 15 minutes while the base of the aneurysm is occluded with clips. Regional vascular occlusion has been achieved by temporarily clamping the vertebral and carotid arteries or by clamping the right innominate, left carotid, and left subclavian arteries through an incision in the neck. If repeated occlusion periods are required to complete the operation on the aneurysm, they may be carried out safely provided that a recovery period is allowed (225).

For any kind of intracranial surgery hypothermia provides the advantages of a reduction in brain size in addition to those of a reduced metabolic rate and it may also reduce the cerebrospinal fluid pressure. Hypothermia has been used, therefore, to facilitate the surgery of various space-occupying intracranial lesions (56, 158, 175, 246). The advantages over conventional methods are not as definite here as they are in the treatment of intracranial aneurysms. If brain shrinkage is the main reason for using hypothermia in the surgery of space-occupying lesions, it may be more effectively and easily achieved by the intravenous injection of urea (138).

[illegible]sion in the application of hypother[illegible]racranial surgery has been Wood[illegible] and Uihlein's (281) use of profound [illegible] Woodhall employed a pump-oxygen[illegible]ator and blood cooling to achieve a brain temperature of 11 degrees C. during craniotomy in a 39 year old man. During the relatively long time when perfusion could be stopped at this temperature, a flaccid bloodless brain was available for operation. If the technique proves to be safe enough, and can be employed in the future, it will doubtless facilitate a number of complex intracranial procedures.

Application of hypothermia to the treatment of head injuries follows from its demonstrated effect in reducing edema. Reduction of the fever which is often a consequence of head injury may also have a beneficial effect. A few experimental studies support the theoretical use of hypothermia in head injuries (230, 237, 241) and clinical experience indicates that cooling helps some patients with serious head trauma (189, 231, 238). Total body cooling for serious traumatic head injury is sound.

Still another type of brain injury for which cooling has been advocated is the injury resulting from massive cerebral hemorrhage (135), but the treatment is not yet established.

A further application of hypothermia for brain injury has been suggested by Williams and Spencer (293), who subjected patients to hypothermia after resuscitation from cardiac arrest. Often in the past an apparently successful restoration of heart function after cardiac arrest has failed, not because of the heart, but because of extensive, irreversible damage to the central nervous system. Cooling seems to reduce the extent of this damage.

A concept that supports most applications of hypothermia for disease or injury of the central nervous system is the concept that hypothermia reduces cerebral edema. It does reduce cerebral edema but the importance of this effect may have been overestimated. Doubt has been cast on the importance of cerebral edema, at least in one experimental situation, by the work of Kaupp and associates (146). Studying the tolerance of dogs and monkeys to cerebral ischemia they found that urea failed to increase the tolerance of the brain to prolonged ischemia even though it caused brain shrinkage. The value of hypothermia in treating brain injury may rest upon other effects.

Finally, two earlier uses of hypothermia for brain disease, no longer in vogue, deserve mention. Fay treated brain tumors with localized and generalized hypothermia as part of his pioneering explorations (94). At about the same time Talbott (279) used hypothermia in treating patients with schizophrenia. Apparently there was some improvement but not a great deal and there were no basic discoveries. The technique demands too much work with too little hope to suggest that anyone should now abandon tranquilizers for cooling.

CANCER

Preceding by more than 20 years the current interest in hypothermia, Fay (93, 95) and Smith (265, 267), in an imaginative series of studies, used both regional and general hypothermia to treat patients with cancer. Their work was based on the idea that cancer cells are more sensitive to cold than are normal cells. Thus, if tissues harboring cancer cells were cooled adequately for a sufficient period of time, the normal cells would survive while the cancer cells would perish. Some support for their attempt is found in the observation that metastatic visceral cancer rarely metastasizes to the cooler areas of the body such as the skin or extremities (95). There was also some experimental work on cell growth suggesting that a critical temperature level might harm embryonic tissues or cancer, while adult tissues survived (266).

In their clinical work patients with widespread cancers were cooled using sedation and surface cooling. After the temperature had reached 90 degrees F. (32 degrees C.), the environment of a cold room was enough to keep the temperature down and it was allowed to remain at about 30 to 31 degrees C. (81 to 88.5 degrees F.) for 4 or 5 days. Originally it was hoped that this treatment would result in shrinkage of the tumor and some cautious optimism was expressed, but it soon appeared both from the work of the originators and that of others (283) that some temporary relief of pain was the only certain effect.

Much more recently, after Niazi and I had learned how to cool warm-blooded animals to near freezing temperatures with survival (203), we decided to re-explore Fay's thesis. Perhaps profound cooling would succeed where the moderate cooling used by Fay had failed. There were some promising results in our first experiments with rat tumors (205) and on the basis of this we cooled 1 woman with a widespread cancer to 10 degrees C. with survival (208). In her case the cooling failed to produce regression of the cancer and some later unreported studies showed that rat tumors other than the first ones we studied also failed to regress. If prolonged cooling were to be effective, it might have to be used for several days, but prolonged deep hypothermia is not possible at present.

ROENTGEN IRRADIATION

Cooled tissues withstand a dose of irradiation which would be lethal during normothermia. Though there has been no practical application of this as yet, cooling could conceivably become a useful technique to protect normal tissues during roentgen therapy for malignancy. It may also provide a way to protect space passengers traveling through zones of high radiation intensity.

The evidence that hypothermia protects against roentgen irradiation is based on experimental work with infant mice (273), hibernating marmots (46), and adult rats (23), all of which withstood a dose of total body irradiation while cold which would have been lethal at normal temperature. Apparently the level of cooling needed to achieve significant protection must be profound. Storer and Hempelmann, for example, found no protection at 29 to 30 degrees C. (273) and the rats studied by Benvenuto and myself (23) were cooled to temperatures below 10 degrees C.; cardiac action had usually ceased during the time of irradiation. As well as being evident in mortality rates, the protective action has been manifest in the leukopenic effect of irradiation which is distinctly less in rats hypothermic during irradiation (67).

The protection provided by hypothermia may simply be a consequence of reduced cell function and growth, as evidenced by a suppressed mitotic activity. Looking for another possible explanation in the relationship between oxygenation and sensitivity to irradiation (117), Storer and Hempelmann (273) suggested that a lower tissue oxygen tension during hypothermia might help to explain the increased tolerance to irradiation.

Hyperthermia, in contrast, increases the sensitivity of tissues to irradiation (247) and it has been used both experimentally and clinically to potentiate the radiation treatment of cancer. In

these efforts, the differential sensitivity of malignant and normal tissues to radiation at elevated temperatures has not been satisfactorily measured. This differential sensitivity is obviously important, for any radiation treatment fails unless the tumor is relatively more sensitive to irradiation than the normal tissues.

In some studies we made of this differential sensitivity during hypothermia in rats innoculated with a lymphoma it appeared that both the tumor and the normal tissue showed an increased tolerance at the lower temperatures with no clear alteration in differential sensitivity (64). If this holds true for human tumors, general hypothermia would not be useful in potentiating the irradiation treatment of cancer but some method of warming the cancer while cooling normal tissues during irradiation might be useful. This would be similar to recent efforts that have been made in cooling the body while warming the target area during the perfusion chemotherapy treatment of cancer (251).

NEONATAL ASPHYXIA

Miller and his associates, who have been studying this application of hypothermia since 1949 (191, 192), provide good evidence that hypothermia will benefit infants suffering from neonatal asphyxia. To begin with they demonstrated that newborn guinea pigs survived asphyxia, produced by breathing 95 per cent nitrogen and 5 per cent carbon dioxide, two to three times longer than their normothermic litter mates. These observations were found to apply to other animal species as well, and a large amount of evidence was amassed before the method was given a clinical trial by Westin, Miller, and associates in Sweden in 1959 (291). At that time they cooled 8 asphyxiated infants to body temperatures of 23 to 32 degrees C., with the addition of oxygenated blood in some. Benefit from the cooling was evident and with one exception these infants survived with no residual evidence of neurologic damage. Lacomme (155) has also advocated hypothermia for neonatal disease, and he uses a combination of drugs plus mild surface cooling to achieve it.

In one of his studies preceding the report on the clinical use of hypothermia for neonatal asphyxia, Miller (193) described some remarkable observations made on cooling a nonviable premature human infant. The infant was repeatedly cooled to near freezing temperatures and appeared to withstand this remarkably well. Heart beat continued even at a body temperature of 0.1 degree C. in contrast to our adult patient, also cooled by surface cooling (208), in whom cardiac standstill occurred a little above 10 degrees C. These observations suggest that human infants, particularly when premature, withstand cooling better than adults, a fairly consistent finding in other animal species.

PROFOUND HYPOTHERMIA

The question "Can man learn to hibernate?," which appeared recently on the cover of a lay magazine (76) revives once more a recurring popular interest. Cold preservation has found such wide usefulness that the imaginative individual asks why an intact animal cannot be preserved in a cold state. Why can't the warm-blooded mammal through appropriate technique be put into a condition of winter sleep? An even more intriguing question comes up. Why can't the warm-blooded animal be frozen solid and preserved viable, indefinitely? Though one cannot yet achieve the ends suggested by these questions, enough new information has become available to make the questions sound rational rather than fantastic. Warm-blooded animals can be cooled temporarily to the levels of temperature reached by hibernators and survive, and mammalian cells, such as spermatozoa or red blood cells, and some bits of mammalian tissue can be frozen solid for a long time and then be revived completely. These are exciting studies. They are well summarized in a review by Smith (261), who has herself made a number of the most important contributions. Gollan, too, in a recent monograph (108) provides a number of important references not easily found elsewhere.

TOTAL BODY COOLING TO NEAR FREEZING TEMPERATURES

Prior to the last decade, investigators had decided that adult, warm-blooded animals could not survive cooling to temperatures below approximately 15 degrees C. Infant warm-blooded animals provided an exception, and Fairfield in 1948 (92) succeeded in cooling infant rats to body temperatures as low as 3 degrees C. with recovery after more than an hour of cardiac arrest. Both she and Adolph (2) in the same year, however, concluded that mature rats could not be cooled below 14 degrees C. with survival. The

prevailing opinion supported theirs (49, 57, 73, 148, 298). Respiration and the heart beat ceased and the animals were assumed to be dead.

Simple denial of this assumption was the key that led to an important advance. Though some suggestion of success is found in the earlier work of Winterstein (295) and Lutz (176), it was Andjus of Belgrade in 1951 (5) who made a clear break-through when he resuscitated adult rats from body temperatures of 1 degree C. Respiration and heart beat in these animals had been at standstill for approximately 1 hour. The method (106) was simple. The rats were placed in a closed jar in a cold environment without anesthesia, and thus exposed to the combined effects of cold, high carbon dioxide, and partial asphyxia. When the body temperature had fallen to between 15 and 20 degrees C., the rats were taken out of the jars and cooled in ice until the body temperature was just above freezing. Resuscitation began with artificial respiration and local heating over the heart and continued with general rewarming once the heart had started to beat well. Later, working with Smith and others in London, this work was confirmed and extended and more efficient devices, microwave in particular, were employed in rewarming the animals (8, 9, 10, 220).

Some time after Andjus had described his original work but before it had come to our attention, Niazi and I were also successful in resuscitating rats from near freezing body temperatures (203) by a different method. Our rats were anesthetized with nembutal, intubated with an intratracheal tube, and attached to a respirator which administered 5 per cent carbon dioxide in 95 per cent oxygen. Surface cooling with refrigerating blankets was employed and electrocardiographic tracings were followed on an oscilloscope. The respirator was stopped when the heart beat ceased—usually at a body temperature of around 9 degrees C. Rats could be successfully revived after 2.5 hours of cardiac and respiratory standstill at near freezing temperatures. Subsequently, we employed the same technique to cool dogs (204, 206), monkeys (207), and finally man (208) to body temperatures below 10 degrees C. with successful resuscitation.

The requirements for successful cooling and revival of warmblooded animals from temperatures below 10 degrees C. are not many. Artificial respiration is not needed, but an increased carbon dioxide level in the respired gas is apparently required, for it is a feature of both the technique described by Andjus and the technique devised by Niazi and myself. We have been unable to obtain consistent survivals in our experiments when pure oxygen was used in the respiratory mixture, and we are therefore inclined to believe that a low carbon dioxide level and perhaps an elevated blood *p*H are detrimental during hypothermia. The amount of oxygen given during cooling is not critical, for though we used high concentrations, Andjus' rats were cooled in a state of partial asphyxia. In the resuscitation of these cold animals, early cardiac rewarming has been important. The heart must start to pump some blood around to the tissues before these tissues may be safely rewarmed. Circulatory inadequacy will often explain failure to withstand profound hypothermia.

It has been established that adult warmblooded mammals can survive low body temperatures in the range achieved by hibernating animals. They can be kept at these low temperatures for only short periods of time, however, and this short tolerance is apparently related to other features that distinguish profound cooling of warm-blooded animals from true hibernation. For example, heart beat and respiration stop in the cooled homotherm while both of these vital functions continue, though at a very slow rate, in the hibernator. The cold nonhibernator is in a state of deep anesthesia when cooled below 20 degrees C.; in contrast, the hibernator remains responsive even at the lowest temperature reached and it will rewarm spontaneously if stimulated or if the environmental temperature goes too low (179). Other significant features of hibernation not successfully copied by the homotherm are discussed in the section on prolonged hypothermia.

EXTRACORPOREAL CIRCULATION DURING PROFOUND HYPOTHERMIA

Gollan and his associates (108, 111, 113) have called attention to the circulatory failure which occurs during profound hypothermia and by adding a pump-oxygenator they have taken a step to correct this failure. With the use of a pump-oxygenator, they were able to cool dogs to a temperature of 1.5 degrees C. and revive them. In some experiments the blood was partially replaced with Ringer's solution in order to lower the viscosity of the circulating fluid. He-

moglobin was not needed at the low temperature, for a sufficient amount of oxygen could be carried dissolved in the blood. This experimental work preceded by a number of years the current interest of cardiac surgeons in the combined use of extracorporeal circulation and profound hypothermia which has been described. In one technique employed by cardiac surgeons the pump-oxygenator is used with blood cooling to achieve profound hypothermia in the manner of Gollan, whereas in another the oxygenator is omitted and only pumps and a blood heat exchanger are found in the extracorporeal circuit.

COOLING MAMMALS TO TEMPERATURES BELOW 0 DEGREES C.

Moving down the temperature scale we find that some small, warm-blooded animals can be successfully resuscitated from brief periods below freezing, these low temperatures being achieved in a supercooled or partially frozen state. Most of the work in this temperature range has been carried out by Smith and her associates who have also studied the near freezing temperatures previously discussed and the deep freezing to be discussed in the following section. In her review (261) Smith has described the earlier attempts at reaching subfreezing temperatures in mammals which led to the conclusion that hamsters and other hibernators could not survive body temperatures below 0 degrees C. Thus, prior to the 1950's, lethal temperatures were assumed to be 15 degrees C. for adult nonhibernators and 0 degrees C. for hibernators. Successful breaching of the 15 degrees C. limit for nonhibernators has been described. The 0 degree C. barrier survival has been at least partially breached, too, through techniques that permit either supercooling or partial freezing of the animal. Total freezing of an animal is still fatal.

In 1954, Smith and her associates (260, 262) reported that hamsters supercooled to temperatures as low as —5 degrees C. could be revived, and Andjus (6) subsequently found that rats could survive supercooling to temperatures as low as —3.3 degrees C. Some of the rats cooled by Niazi and me (203) survived body temperatures as low as —4 degrees C. More significant, perhaps, than survival of these supercooled animals, has been survival of animals in which some of the tissues were actually frozen. Hamsters progressively frozen for up to 60 minutes by Smith at body temperatures of —2.5 degrees C. could be revived, but not if the freezing had continued for more than 60 minutes, nor if the body temperature fell below 5 degrees C. Animals sacrificed while frozen in this manner showed ice crystals on the outer surface of the abdominal viscera and within the substance of the brain. Calorimetric determinations in these sacrificed animals showed that up to 45 per cent of the body water had been converted to ice. Apparently 50 to 60 per cent of the water in the brain was frozen. Thus, we have a new cold barrier for mammals, which may now be placed a few degrees below freezing with part of the body water actually converted to ice.

FREEZING WITH VIABLE PRESERVATION

The most startling achievement in low temperature biology has been the preservation of cells at temperatures far below freezing with complete functional recovery. This triumph is again the work largely of the group at Mill Hill, London, whose accomplishments with hamsters and rats in the near-freezing range, have been described in previous sections. Their success with subfreezing temperatures was the culmination of many efforts to preserve mammalian cells by freezing, and it preceded their work with hamsters and rats at the near-freezing temperatures. To some extent it was fortuitous.

Viable preservation of organisms and cells through freezing had been studied during the nineteenth century and first decades of this century, so that by 1940 it was recognized that survival at temperatures below freezing was possible only in organisms in which crystallization of ice could be avoided by preliminary dessication, by supercooling, or by vitrifying the tissue fluids. Though some minute creatures living in ponds survive dessication and freezing under natural conditions, dessication did not appear to offer much promise for mammalian cells because the drying alone would ordinarily be fatal.

Supercooling, too, appears to allow some small animals to survive subfreezing temperatures. In this state some insects withstand body temperatures as low as —40 degrees C. but supercooling is an unstable state, since the water may suddenly crystallize to ice. Furthermore, chemical changes are not completely arrested at temperatures which are possible with supercooling and thus long term viable preservation would be impossible. Viewing the inadequacy of dessication and supercooling, it appeared to

some observers that vitrification would potentially be the best method for viable tissue preservation. Vitrification, which depends upon the cooling of small amounts of fluid at such a rapid rate that crystallization does not take place, was apparently achieved by Luyet and Hartung (177, 178) in frog spermatozoa and vinegar eels. In the 1940's this concept of ultrarapid freezing of protoplasm to prevent destruction by crystallization was accepted but it did not appear to have wide application. Only minute amounts of fluids could be dealt with and the warming as well as the cooling had to be at an ultrarapid rate.

At this point in the history of freezing techniques the group at Mill Hill made their striking discoveries which depended, as with many other discoveries, on the wise exploration of an accidental observation. Polge, working on the biology of fowl spermatozoa, was trying to develop techniques of preserving semen. When glycerol was used accidentally—rather than a physiologically more compatible solution—in one of the experiments, these workers found that the damaging effects of freezing were prevented and the spermatozoa returned to full activity when rewarmed (222). Their first attempts to repeat these experiments with mammalian spermatozoa were not successful but, later, when a method of relatively slow cooling of bull spermatozoa in a glycerol solution was developed (263, 264), preservation at —79 degrees C. and subsequent revival were achieved. This technique for preserving bull spermatozoa, combined with artificial insemination, provided the dairy industry with a potent new method of improving the dairy stock. Now cows can be inseminated with semen from high-grade bulls, even though the semen may have to be shipped for great distances or preserved for great lengths of time. Human spermatozoa, too, have been preserved with this technique (54, 63) though extensive practical utilization is probably not imminent.

Soon this technique of slow freezing in a glycerol solution was applied to other cells and tissues (259). Its most important human application has been in the viable preservation of red blood cells. After Smith's observation that red blood cells could be frozen to —79 degrees C. without disintegration when cooled in 15 per cent glycerol (258), a considerable amount of work was done to make this a practical method of blood storage. Sloviter (257) and Mollison and Sloviter (194) found that the glycerol could be removed by dialysis after rewarming the cells and that these thawed cells could then be used safely for transfusion. They appeared to behave as do red cells which have been stored by conventional methods for short periods of time. Even 2 years of storage was possible, with 90 per cent recovery of functional cells (58). The technique has been improved with the use of a Cohn centrifuge (280) and Haynes and his associates (124) have reported on the clinical use of more than 1,000 units of blood preserved in this way. The gas exchange dynamics of glycerolized frozen blood has been good (210) and this blood has been used for extracorporeal circulation as well as for conventional transfusions (209). The potential value of this new method for prolonged blood storage is obviously great.

After these achievements with spermatozoa and red blood cells, steps were taken to preserve organs by means of freezing in glycerol. Here, too, there has been some success. Rat ovarian tissue, sliced and frozen in 15 per cent glycerol, is functional when rewarmed and implanted in ovariectomized rats (216). Rat testicular tissue has also been preserved viable by this technique (215), as have adrenal cortex (217), mouse splenic tissue (19), and human bone marrow (99). In these experiments with organ preservation, size has been a critical limiting factor, however, and though small bits of tissue have been frozen and revived it has been impossible to revive larger organs. Puppy hearts, for example, have been supercooled with glycerol, but they do not withstand freezing (20). Our experience has been similar (65). An organ, such as a dog heart, which is large enough to require perfusion during the cooling and the rewarming process has not survived freezing. During rewarming a vascular block occurs which prevents perfusion of the organ. Success with organs which require perfusion would appear to be a necessary achievement before the entire animal could be successfully frozen and revived.

Prolonged Hypothermia

Prolonged hypothermia, carried on for many hours or days, not only has potential medical use and possible use in space travel but also it provides a good way of studying the abnormal physiology of hypothermia. Through prolongation, physiologic changes which are ordinarily slight and difficult to detect become magnified.

Fisher and his associates (97, 100) have described many of the changes that occur during prolonged hypothermia and recently we have confirmed some of these studies and added a few additional observations (161). In the dog a type of shock develops which is often irreversible on rewarming. The blood pressure falls, as does the plasma volume and the total blood volume, while there is a striking rise in hematocrit. Evidence of inadequate tissue perfusion appears as the p_H and venous oxygen saturation fall despite a continued high level of arterial oxygen saturation. Blood "sludging" is observable in the small arteries and veins. At autopsy a hemorrhagic small bowel mucosa is found which has characteristically been found in endotoxin or hemorrhagic shock in the dog. The findings in prolonged hypothermia suggest that the basic difficulty may be an improper small vessel reactivity leading to inadequate tissue perfusion, anoxia, and death. Loss of plasma from the blood could be due to the development of a high capillary pressure, vessel wall damage secondary to anoxia, or both. As a consequence of these adverse changes there has usually been a high mortality rate which we have found to be 60 to 70 per cent among dogs cooled to 22 to 23 degrees C. for 20 hours or longer.

A number of treatments which might favorably alter this situation have suggested themselves, but so far we have found none that satisfactorily changed the physiologic pattern of prolonged hypothermia. We have tried 5 per cent carbon dioxide respiration, dibenzylene, chlorpromazine, vasoxyl, cortisone, intravenous administration of saline, heparin, exsanguination, splenectomy, and reserpine.

Safe prolonged hypothermia should be something like the winter sleep of hibernating animals. Thus, investigators who have studied hypothermia have looked to the students of hibernation for guidance and some have been led to an investigation of hibernation themselves (185). It is obvious that hibernators differ from hypothermic nonhibernators (22, 60, 61, 129, 179). There are basic similarities, of course, such as the slow pulse rate, reduced metabolic rate, and rising hematocrit, but the differences attract more interest, for they may suggest ways in which the homotherm may possibly be temporarily converted into a hibernating animal.

In the hibernator, the heart continues to beat, respiration continues though at a very slow rate, and the nerves continue to conduct impulses, even at temperatures of 3 to 5 degrees C. In hypothermic warm-blooded animals, respiration ceases between 15 and 20 degrees C., the heart stops beating between 6 and 12 degrees C., and nerve fibers apparently do not conduct at temperatures below 8 degrees C. Furthermore, the hibernator can rouse himself and does so at intervals without external stimulus. The cooled homotherm will not rewarm himself when cooled to very low temperatures and dies if rewarming is not applied externally. Apparently the hibernator can change saturated fat, normally solid at 5 degrees C., into unsaturated fat which is liquid at this temperature.

As manifest by its pink paws, the hibernator's peripheral vessels dilate. With this vasodilatation plus a slow pulse rate its blood pressure must be extremely low yet its tissues are adequately nourished. It is likely that small vessel reactivity and regional distribution of blood are more suitable to cold in the hibernator than they are in the nonhibernator. Many but not all of the differences between hibernators and nonhibernators could be due to differences in circulation through the small vessels.

A feature of hibernation that is difficult to explain in a simple way is the incompletely defined process by which hibernation is initiated. It is not easily set in motion. External cooling, with or without anesthesia, in a hibernator does not lead to a state of hibernation (134, 224). The hibernator withstands prolonged artificially induced hypothermia better than the nonhibernator, but he can be kept cool with hope of survival only for a fraction of the time that he will survive low temperatures while hibernating. For example, Popovic (224) found that the ground squirrel, which is a hibernator, would fail to recover after 60 to 70 hours of hypothermia, whereas this animal will hibernate naturally for several weeks without difficulty. The complex physiology of hibernation is not yet understood but as more is learned about it hypothermia will surely become safer and more useful.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

EYES

Displacement of the Orbital Floor and Traumatic Diplopia. T. KEITH LYLE. *Brit. J. Ophth.*, 1961, 45: 341.

IN MANY CASES of fracture of the orbital bones a residual diplopia remains after appropriate treatment of the fracture. This residual diplopia must then be treated by corrective extraocular muscle surgery.

The author reports 18 such cases of unilateral fracture of the orbital bones. He divides them into four groups on the basis of bones involved and tabulates the ocular anomalies in each group. In each case operation was performed on the indicated extraocular muscle or muscles and in almost every case binocular single vision was obtained. A slight muscle imbalance remained in a few cases. —*David Shoch.*

Levator Resection for Minimal Ptosis: Another Simplified Operation. R. M. FASANELLA and JAVIER SERVAT. *Arch. Ophth.*, Chic., 1961, 65: 493.

AFTER a brief discussion of operation for ptosis and its difficulties and failures, the authors described a modification of levator resection indicated only for patients with a minimal degree of ptosis and demonstrating a fair lid fold. The modification consists essentially in a block resection of tarsus, levator, Müller's muscle, and conjunctiva, not exceeding 3 mm. of tarsus, levator, and Müller's muscle and a total of 6 mm. of conjunctiva.

The anatomy of the lids is reviewed and illustrated in detail and the technique of the operation is described. For ptosis of greater extent the authors use other modifications of the Blascovic method.

—*Ray K. Daily.*

Intravenous Hypertonic Urea in the Management of Acute Angle-Closure Glaucoma. KEVIN HILL, JEREMY B. WHITNEY, and ROBERT R. TROTTER. *Arch. Ophth.*, Chic., 1961, 65: 497.

THIS IS A REPORT of an investigation on the intravenous injections of urea to lower intraocular tension, a method but recently introduced into ophthalmic practice. The material for the study comprises 11 patients with primary angle closure glaucoma and 2 patients with glaucoma secondary to iris bombé.

The course of the intraocular tension that follows the injection of urea is illustrated by a detailed report of 2 cases. In 10 eyes the tension fell to 20 mm. or less, in 2 eyes the lowest level of posturea tension was 40 to 45 mm. The reduction in tension was unrelated to relief or angle closure and appeared to result from the osmotic action of urea. In 2 cases the rapid administration of urea was followed by a transient agitated confusional state. The method of administration and side effects are described in detail.

—*Ray K. Daily.*

Significance of Minor Eye Signs in Headache of Migraine Type. E. CHARLES KUNKLE and W. BANKS ANDERSON. *Arch. Ophth.*, Chic., 1961, 65: 504.

THIS IS an analysis of the ocular signs of 98 patients suffering cluster headache which is vascular in origin. The ocular signs are discussed under two divisions; those caused by a parasympathetic discharge and those caused by paresis of the sympathetic nervous system.

Seventy-five per cent of the patients had symptoms attributed to an integrated parasympathetic discharge emerging from the brain stem over the third and seventh, and rarely over the tenth, cranial nerves. These symptoms were unilateral injection of the bulbar conjunctiva and excessive lacrimation. Associated with these symptoms were nasal rhinorrhea and in 2 cases bradycardia. Seven patients had a moderate miosis. The symptoms attributed to damage of the sympathetic fibers in the wall of the internal carotid artery are miosis and ptosis, found in 6 patients, and miosis alone in 2.

The diagnosis of sympathetic paresis was confirmed by pharmacologic tests. The pathogenesis and ocular symptoms are discussed in detail and the literature on the subject is briefly reviewed. —*Ray K. Daily.*

EARS, NOSE, AND SINUSES

Congenital Nasal Dermoid Cysts and Fistulas. A. H. M. LITTLEWOOD. *Plastic & Reconstr. Surg.*, 1961, 27: 471.

CONGENITAL DERMOID CYSTS and fistulas of the nose may be noted at birth or childhood but some may go unrecognized into adult life. The fistulas may open at any point on the middorsal line of the nose. The fistulous tract always follows an upward-inward direction, running in front of or behind the nasal bones to a cyst. Although many of the cysts are superficial in location some are deeply located beneath the nasal bones or in the nasal septum. Some lie deep in the

substance of the ethmoid and sphenoid bones near the hypophysis.

The embryology of the nasal septum is reviewed and theories of origin of nasal dermoid cysts and fistulas are discussed. There is evidence that the deeper type of cyst may originate from persistence of epithelial elements included in the nasal septum during development.

Six cases of congenital nasal dermoid cysts and fistulas are presented. Treatment should consist of excision of the fistula and exposure and complete removal of the cyst. The deeply located cysts may not be recognized and if they are not excised will lead to a recurrence of the draining fistula.

—*Harvey W. Baker.*

MOUTH AND HYPOPHARYNX

Hypoplasia of the Mandible with Glossoptosis in Infants (Ipoplasia mandibolare e glossoptosi nel neonato). Francesco Minervini. *Ann. ital. chir.*, 1961, 38:72.

Five cases of hypoplasia of the mandible with glossoptosis and cleft palate were observed in the last decade at the Presbyterian Hospital of New York City. The author of this article studied the medical records of these patients during his stay at the aforementioned institution.

The 5 cases are summarized in this article and a review of the literature and some general considerations on the subject are presented as well. All patients were infants. They all were surgically treated and different techniques were used. No details, however, are given in this respect. According to the author the operation devised by Douglas is the most apt to give satisfactory anatomic and functional results. The prognosis of this condition when correctly diagnosed and properly treated is not as poor as considered in the past. —*Maria Serratto.*

Immediate Reconstruction of the Mandible in Tumor Surgery. Duncan M. McKee. *South. M. J.*, 1961, 54: 620.

Major resection of the mandible may seriously disrupt the dynamics of speech and swallowing and, at times, of breathing. The facial deformity may also produce severe emotional reaction. The author makes a plea for immediate replacement of the mandible with an autogenous bone graft when feasible at the time of operation for tumors.

Immediate reconstruction of the mandible after resection of malignant tumors of the oral cavity depends on enough soft tissues remaining in the mouth for adequate closure and coverage of the graft. This reconstruction may be possible after excision of carcinoma of the gingiva with little or no extension into the floor of the mouth. If immediate replacement of the mandible is not possible, temporary use of a stabilizing bar or rod may be effective. Such appliances are seldom permanent and most are extruded within a few months, but they can minimize displacement of mandibular fragments prior to restoration of the mandible with a bone graft. Tumors arising in the soft tissues outside the oral cavity such as the skin and the salivary glands, which require mandibular resection, lend themselves more frequently to immediate bone grafting. Immediate bone grafting for defects after excision of primary tumors of the mandible is also often feasible.

Two factors are of basic importance in primary restoration of the mandible by bone graft. These are adequate immobilization and adequate coverage of the graft with soft tissues with the avoidance of dead space. Iliac bone is the preferred source for the graft. The ends of both graft and mandible are cut to form a lap or scarf joint and a single steel wire passed through drill holes is used for fixation.

—*Harvey W. Baker.*

Corrections of Deformities of the Lower Part of Face (Korrekturen von Formfehlern im Untergesicht). H. Köle. *Langenbecks Arch. klin. Chir.*, 1961, 297: 67.

The main points in judging the profile picture in the vertical line are as follows: (1) the hairline, (2) the nasal point as the deepest point of the nasal saddle, (3) the subnasal point, and (4) the chin point. The lower part of the face takes in the area between the subnasal point and the chin, including the latter.

Deformities of the lower part of the face are described in five groups: (1) overdevelopment of the lower part of the face, prognathism; (2) underdevelopment, imperfect development or congenital smallness; (3) asymmetry; (4) lower part of face being too high, open bite; and (5) lower part of face being too short, under bite.

Each group is elaborated on by case reports with descriptions of surgical and prosthetic corrections. Preoperative and postoperative photographs of patients are included. —*O. Erik Hallberg.*

Lymphangiomas of the Tongue. Thaddeus J. Litzow and Harvey Lash. *Proc. Mayo Clin.*, 1961, 36: 229.

The report concerns lymphangioma of the tongue observed in 46 patients, 24 male and 22 female, from 1950 to 1959 inclusive. Although most patients, 76 per cent, were less than 20 years of age, 5 were more than 40.

The tumors usually involved the dorsum of the tongue anteriorly, but in 5 instances they were basilar, in 2 extending into the epiglottis. Size varied considerably; in 19 instances the tumor involved at least one-half of the tongue.

Symptoms included recurrent swelling and soreness of the tongue secondary to frequent infection. Fright or bewilderment was sometimes a symptom. The commonest physical sign, pathognomonic when associated with macroglossia, was irregular nodularity of the surface of the tongue.

Cystic hygroma was present in 3 patients, or 7 per cent; this is considered striking in view of the relative infrequency of either condition in the population.

Since lymphangiomas are benign, the authors believe treatment should be given only to control symptoms. Often no treatment was advised, even for extensive lesions. Wedge resection or hemiglossectomy was performed in 6 cases, electrocoagulation in 3, and excision of small lesions in 8. Radon seed implantation was used occasionally after operation or electrocoagulation. Seven patients had been treated elsewhere.

Two patients subjected to extensive procedures had prophylactic tracheotomies because of anticipated postoperative edema of the tongue.

Multiple Oral Carcinomas. GEORGE S. SHARP, WELDON K. BULLOCK, and JAMES T. HELSPER. *Cancer*, 1961, 14: 512.

THE AUTHORS reviewed 275 consecutive cases of oral carcinoma in which 28 patients or 10 per cent had multiple primary lesions. Sixty-two histologically proved lesions were present or 2.2 lesions per patient as compared to 1.1 for the entire series.

Squamous carcinoma was seen in lesions. The following criteria were used to establish primary multiple lesions: (1) invasion must be shown microscopically and (2) simultaneous and subsequent lesions must be grossly and microscopically separate with at least 1.5 cm. of nonneoplastic tissue between them.

Microscopic studies showed many structural alterations in the squamous and underlying tissues associated with epidermoid carcinoma of the oral cavity. These abnormalities include inflammation, fibrosis, atrophy, hyperplasia, and carcinoma in situ. Atrophy and hyperplasia were seen in all specimens examined and were adjacent to the carcinoma or randomly distributed. Stomatitis was present in wide areas surrounding the carcinoma, particularly in atrophic areas. This study supports the belief that the mucous membranes of patients with oral cancer are abnormal and produced by intrinsic, extrinsic, and systemic carcinogens. Intrinsic factors include chronic infection, periodontal disease, jagged teeth, dentures, and inflammation of salivary glands. Extrinsic factors include excessive use of tobacco, alcohol, heat, and spicy foods. Systemic factors are thought to account for diminished resistance of mucous membranes to average oral insults.

The authors have noted that atrophy was the most common precancerous mucosal change and frequently preceded leukoplakia. Visually the atrophic area may be local or generalized. Leukoplakia was seen in 90 per cent of patients in this study. Simultaneous multiple primary carcinomas were seen in 6 patients, 1 had 3 separate lesions. The longest interval between 2 primary carcinomas was 7 years and the shortest 6 weeks. Therefore patients are advised to return at 3 month intervals for check-up. Cervical lymph node involvement was seen in 7 patients. Surgical intervention including mandibulectomy and neck dissection or radiation therapy was the form of treatment. Of 28 patients 14 are alive 5 or more years.

The authors are of the opinion that correction of certain clinicopathologic conditions predisposing to cancer on the oral surfaces might prevent multiple oral carcinomas. —*John Hudock.*

Distant Metastasis of Oral Carcinoma. DAVID S. TOPAZIAN. *Oral Surg.*, 1961, 14: 705.

THIS STUDY is based on autopsy findings in 83 fatal cases of oral carcinoma observed at the Philadelphia General Hospital, Philadelphia, Pennsylvania. Distant metastasis, that is, spread of the disease to organs or tissues below the level of the clavicles, was found in 20 autopsies or 24 per cent. In 15 or 75 per cent metastatic disease was in the lung. The liver and adrenal glands were less frequent sites of distant spread. In order of frequency, the tonsil, floor of mouth, palate, and tongue were the primary foci most often associated with distant spread. Metastases were correlated with poor cellular differentiation of the tumor. In all cases in which distant metastases were observed, regional cervical disease was present.

The author concludes that distant metastases occur more frequently than is generally suspected. This observation should be considered in the management of patients, especially if there are cervical metastases.

—*Jerome J. DeCosse.*

NECK

Carotid Body Tumors. R. P. JEPSON and L. J. OPIT. *Austral. N. Zealand J. Surg.*, 1961, 30: 175.

THE IMPORTANCE of carotid body and allied tumors, such as paraganglioma intravagale, lies not in their frequency but in the way a difficult decision concerning the life and death of the patient is suddenly thrust on the operator who comes unexpectedly on such a lesion. The high mortality from carotid body tumors can be attributed to (a) lack of a preoperative diagnosis and (b) the dangers of resection of the carotid bifurcation. The clinical diagnosis of such tumors is discussed and the value of carotid angiography outlined. It is suggested that it is never justifiable to resect the carotid bifurcation. Tumors should be either removed by dissection with preservation of the carotids or dealt with by intracapsular enucleation and roentgenotherapy.

—*W. Foster Montgomery.*

Carcinoma of the Thyroid. E. MEREDITH ALRICH, RICHARD H. BLANK, and M. SHANNON ALLEN, JR. *Ann. Surg.*, 1961, 153: 762.

THE CLINICAL COURSE of cancer of the thyroid is quite varied and is dependent both upon the biologic nature of the disease and upon the effectiveness of various types of treatment. The microscopic picture of these neoplasms enables differentiation of these tumors into groups which, in turn, can be shown to have quite different clinical courses. The histologic appearance is indicative of the biologic characteristics of each group irrespective of treatment; therefore, the type of therapy indicated for cancer of the thyroid should be dependent upon pathologic classification of the tumor.

The cases of 82 patients with thyroid carcinoma who were treated at the University of Virginia Hospitals, Charlottesville, Virginia, between 1938 and 1958 were reviewed. The tumors were classified into five groups: pure papillary, mixed papillary and follicular, follicular, Hürthle cell, and anaplastic carcinoma. In one half of the patients the tumor was limited to the thyroid gland. The surgical procedures performed ranged from simple biopsy only to total thyroidectomy with en bloc resection of involved adjacent structures. The percentages of patients who had positive nodes initially or later were as follows: papillary 59 per cent, mixed papillary and follicular 36 per cent, follicular 50 per cent, Hürthle cell 71 per cent, and anaplastic 25 per cent.

Radiation therapy in the form of conventional roentgen rays, cobalt, or radioactive iodine was used

in conjunction with surgical therapy in 27 patients. The response to roentgen rays and cobalt was poor. The response of 5 patients receiving therapeutic doses of radioactive iodine was favorable even though the iodine was used in a palliative manner. The use of thyroid extract or tri-iodothiodyne as palliative treatment of residual or recurrent disease frequently resulted in regression of the disease. It is the authors' belief that all types of thyroid carcinoma should be treated prophylactically after any definitive and presumably curative surgical procedure.

The highest mortality rate was seen in the Hürthle cell group and a more radical approach, namely, prophylactic neck dissection with partial or total thyroidectomy, is recommended for this type of thyroid cancer. The cumulative mortality rate for the entire series was 35 per cent which indicates the relatively grave prognosis of thyroid carcinoma. Patients even with pure papillary tumors not infrequently die from persistent or recurrent thyroid carcinoma. In this series, 21 per cent were in this category.

—*Lloyd D. MacLean.*

Cord Movements After Thyroidectomy. GUY BLACKBURN and L. F. W. SALMON. *Brit. J. Surg.*, 1961, 48: 371.

THIS ARTICLE reports a study of the vocal cord movements in 250 consecutive patients on whom thyroidectomy was performed. Laryngoscopy was performed prior to and after operation. Unilateral cord paralysis occurred postoperatively in 9 cases, in 5 of which it proved permanent. In the other 4 there was recovery within 3 months.

All of these operations were performed by one surgeon and the recurrent nerve was invariably exposed on each side and the inferior thyroid artery divided. In no instance was the nerve found traversing the substance of the thyroid gland. The recurrent nerve was more liable to trauma when there was retrotracheal and retrosternal extension of the gland. A previous operation on the thyroid gland was the most important factor making exposure of the nerve difficult, but in this series never prevented it.

Endotracheal anesthesia was employed in these cases. Laryngoscopy performed immediately at the completion of the operation is unreliable, and information concerning cord movements obtained at this time may be misleading. Laryngoscopy in this series was carried out 3 to 5 days after thyroidectomy by the indirect method and was repeated only when some abnormality was found.

Information from this study clearly indicates that postoperative hoarseness is not necessarily an indication of nerve damage. Most of these patients are hoarse for a day or two after operation, probably to a considerable degree because of endotracheal anesthesia. Furthermore, it cannot be assumed that a patient who notices no alteration in his voice has intact laryngeal nerves. Two of the patients in this series, each of whom 5 days after operation was found to have complete paralysis of one cord, had noticed no change in the voice. None of the 5 patients whose cords remained paralyzed continued to complain of dysphonia after periods of from 10 weeks to 6 months after operation.

Paralysis of the recurrent nerves may be due to traction on the gland, and dislocation of the lateral lobe with the finger is probably the easiest way of producing this. Therefore the authors have a marked preference for dividing the pretracheal muscles. With adequate retraction the vessels may then be divided prior to sectioning of the glands and the risk of stretching the nerve is lessened. Although exposure of the recurrent nerve is probably the best safeguard against injuring the nerve, it does not make postoperative laryngoscopy unnecessary. —*E. Thomas Boles.*

SURGERY OF THE NERVOUS SYSTEM

CEREBRUM, CEREBELLUM, AND HYPOTHALAMUS

Craniopharyngiomas. SIMON KRAMER, WYLIE MCKISSOCK, and JOSEPH P. CONCANNON. *J. Neurosurg.*, 1961, 18: 217.

SINCE CRANIOPHARYNGIOMAS arise from squamous epithelium it was thought reasonable to irradiate such tumors after minimal surgery consisting of biopsy and evacuation of a cyst, using the radiation to deal with the residual solid tumor and to prevent refilling of the cyst. A tumor dose of 5,500 r in 6 weeks for children and 7,000 r in 7 weeks for adults was delivered using a rotational megavoltage technique.

A 6 year follow-up is presented of 6 children and 10 adults so treated. The diagnosis was proved by surgical biopsy in 3 and strongly suggested by the aspiration of fluid rich in cholesterol crystals in 5 others. None of the patients has died from the intracranial tumor. Three patients have some residual visual difficulty and 1 adult complained of failing vision 1 year and 3 months after treatment, which required further cyst aspiration. Five of the 6 children are attending school full-time and none has shown a recurrence, as compared to the appreciable recurrence early in a non-irradiated series elsewhere.

—Joseph Ransohoff.

The Pneumoencephalographic Appearance of the Cisterns in Posterior Fossa Tumors (Zisternale pneumographische Erscheinungsbilder bei raumbeschraenkenden Prozessen der hinteren Schaedelgrube). M. ROTH. *Fortsch. Röentgenstrahl.*, 1961, 94: 369.

THE CASE REPORTS are presented of 6 patients with space-occupying lesions of the posterior fossa. Similar pneumoencephalographic findings were present in each case. The median or paramedian cisterns were dilated, including the quadrigeminal, ambient, vela interposita, and corpora callosa.

The widening of these cisterns in the presence of noncommunicating hydrocephalus appears paradoxic. The author proposes that with transtentorial herniation, the apex of the tentorial incisure is the last area to be completely occluded. Therefore, these cisterns become dilated when the other pathways from the posterior fossa are obstructed.

—Sanford Larson.

Bleeding Aneurysms of the Basilar Artery. CHARLES G. DRAKE. *J. Neurosurg.*, 1961, 18: 230.

BECAUSE of limited surgical experience with these lesions, 4 cases are discussed in which a basilar aneurysm was attacked directly in urgent fashion because of repeated bleeding. Three patients were operated upon within 24 hours of the last hemorrhage and the other 36 hours after.

The upper one-third of the basilar artery and its bifurcation were exposed by an anterior subtemporal approach through the tentorial opening into the interpeduncular cistern. During induction of hypothermia preliminary dissection of the neck was carried out with both common carotid arteries isolated under tapes, and both vertebral arteries were exposed. Total interruption of the cerebral circulation for brief periods of approximately 5 to 8 minutes at a body temperature between 26 and 28 degrees C. was utilized with at least 5 minutes allowed between interruptions. After exposure the aneurysm was obliterated by application of a McKenzie clip.

One patient died after gradual onset of hyperventilation and hypotension and 1 died as a consequence of cardiac standstill. In certain instances in which expectancy of life is poor, as with repeated hemorrhages, a direct attack appears justifiable.

—Allan D. Callow.

Anticoagulants in Neurosurgery (Anticoagulants et neurochirurgie). P. DESCUNS, H. GARRÉ, A. RAMÉE, and CH. THEVENOT. *Ann. chir.*, Par., 1961, 15: 147.

THE AUTHORS recommend the carefully controlled use of anticoagulants in the surgery of parasagittal tumors, of wounds involving the major dural sinuses, and of some intracranial aneurysms in order to limit thrombosis of the intracranial vessels. Illustrative case reports are presented. *—Sanford Larson.*

Accurate Placement of Ventriculoatrial Shunt for Hydrocephalus Under Electrocardiographic Control. JAMES T. ROBERTSON, ROBERT W. SCHICK, FRED MORGAN, and DONALD D. MATSON. *J. Neurosurg.*, 1961, 18: 255.

SINCE shunts into the right atrium via the jugular vein for hydrocephalus have increased in popularity, a convenient method for assuring that the tip of the catheter is within the atrium, where turbulent flow will prevent thrombus formation, is welcome. The authors have reviewed and modified the classical intracardiac and intravascular electrocardiographic changes to the shunting procedure.

The cardiac catheter is used as an electrode by filling it with 3 per cent saline solution. As the sinoatrial node is passed, there is a reversal and biphasic configuration of the P wave.

The experience with this procedure in 38 patients is described. *—Joseph Ransohoff.*

CRANIAL NERVES

Extracranial Neurogenic Tumors of Head and Neck (Tumores nervosos extracranianos do segmento cefálico). RENATO CAPPELLANO and HUMBERTO TORLONI. *Rev. paul. med.*, 1961, 58: 73.

THE AUTHORS PRESENT 14 cases of peripheral nerve tumors seen on the Head and Neck Service at the São Paulo Cancer Institute, Brazil. There were 8 men and 6 women, mostly between the ages of 30 and 60.

Eight patients had neurilemmomas, which are benign, solitary, encapsulated, and of varying size depending on their nerve of origin. They grew slowly and produced few symptoms; eventually nerve trunk

pain or paresthesias developed in the larger ones. Photographs of neurilemmomas show their capsule, their attachment to a nerve sheath, the cystic, solid, or hemorrhagic interiors, and characteristic microscopic pictures of fusiform cells arranged in dense plexiform whorls. Treatment is local excision, and the tumors seldom recur.

The neurofibromas are characterized by a diffuse proliferation of peripheral nerve elements, in contraposition to the encapsulated neurilemmomas. They are occasionally single, but more often part of the complex of von Recklinghausen's disease. They grow in the nerve endings in the skin, circumscribed nonencapsulated nodules, sometimes pedunculated, with or without melanin pigmentation. Neurofibromas can form and grow within a bone, producing destruction and deformity.

About half of the reported cases of malignant schwannoma have been in patients with von Recklinghausen's disease. They occur at any age, but usually in old people. They do not usually produce symptoms—neither pain nor paresthesia. They metastasize by the blood stream, rarely by the lymphatics. They produce a fusiform enlargement of a nerve trunk or grow in the terminal portion of a branch. Microscopically they are pleomorphic, with cells of varying size and shape with dark staining nuclei closely packed in no orderly arrangement.

One of the patients with a malignant schwannoma is alive and well 6 years after wide excision of his tumor arising in the left parotid region. The other patient died of a recurrence of a paranasal sinus schwannoma 2 years after roentgenotherapy.

Of these 14 peripheral nerve tumors, 5 were cervical, 3 were in the parotid area, 1 was orbital, 1 labial, 1 lingual, 2 laryngeal, and 1 in a paranasal sinus. The clinical impression was correct only 5 times; diagnosis is difficult because of the absence of pathognomonic symptoms. Pietrantoni refers to this as the "paradoxical absence of neurologic symptoms" in neurogenic tumors.

The importance of these tumors is that they are mostly benign and resectable, but by their rarity they are frequently confused with other clinical entities including malignant lesions, and they are treated as such. Biopsy is essential to diagnosis and treatment should be surgical. —*William B. Gallagher.*

SPINAL CORD

Value of Cordotomy for the Relief of Pain. Saul A. Frankel and James D. Prokop. *N. England J. M.*, 1961, 264: 971.

This is a review of 103 cordotomies performed on 75 patients. Permanent relief of pain within the follow-up period, averaging about 1 year, was reported by 62 per cent of the patients. Complete relief that proved to be only temporary was experienced by 29 per cent of them.

Cancer was the commonest cause of intractable pain, being present in 79 per cent of these patients. The operation was most successful in this group of patients.

In the majority of patients, the pain was initially only unilateral but, after a 1 stage procedure, pain would occur in the opposite side. This phenomenon may result from relief of a more intense pain that previously occupied the patient's full attention. Patients who were addicted to narcotics prior to cordotomy were much easier to wean off their drugs after a successful procedure.

Sixty-five of the patients were operated on with local anesthesia. The use of local anesthesia gave an opportunity to perform a sensory examination before the wound was closed and contributed significantly to a successful outcome. Return of pain after initial complete relief by cordotomy was noted in 22 cases. In most cases the failure of cordotomy was considered to be due to an inadequate incision.

There were 8 operative deaths, the deaths occurring in the elderly debilitated patients. The commonest postoperative complication was urinary incontinence which was usually temporary. The incidence of urinary incontinence was higher after bilateral than after unilateral cordotomy. When bilateral cordotomy was performed in 2 stages incontinence was less than when it was performed in 1 stage. Weakness of the ipsilateral lower extremity was noted in 31 cases but was usually temporary. —*Morris Sanders.*

Follow-Up of Surgically Treated Herniated Nucleus Pulposus (Enquête sur 82 cas de hernie discale opérés). F. Layani, Y. Chaouat, and C. Bénichou. *Sem. hôp. Paris*, 1961, 37: 1035.

In order to evaluate the long term results of removal of the herniated nucleus pulposus, questionnaires were sent to patients who had been operated upon between 1 and 6 years previously. Eighty-three of 113 responded. Twenty-one letters were returned undelivered, and 9 of the patients did not reply to the questionnaire.

Of the 83 who responded, 51 per cent were either completely free of symptoms or had only occasional mild discomfort. Twenty-seven per cent were benefited but continued to have enough pain to interfere with normal activities upon occasion. Fourteen per cent of the patients have lost from 16 to 60 days of work after operation because of recurrent symptoms, and 8 per cent have lost more than 60 days.

—*Sanford Larson.*

SURGERY OF THE INTEGUMENT AND CONNECTIVE TISSUES

SKIN AND SOFT TISSUES

The Surgical Treatment of Keloids. B. Cosman, G. F. Crikelair, D. M. C. Ju, J. C. Gaulin, and R. Lattes. *Plastic & Reconstr. Surg.*, 1961, 27: 335.

Thirty-two hundred case records of patients with the diagnosis of scar or keloid from the period of 1932 to 1958 at the Presbyterian Hospital, New York City were reviewed. Seventy-two per cent of the cases studied were determinate, indicating that a follow-up period of 1 or more years had been achieved or a recurrence had been recorded.

This review tends to cast doubt on several previously accepted observations. Although it is unquestioned that there is a greater tendency toward keloids in Negroes, the exact proportion is still not definitely established. Some factors for which etiologic importance is claimed in the literature, such as hyperthyroidism and the influence of the female sex hormone, have not been confirmed. The heredity factor in keloids remains strong but is not explainable. The few reports on malignant changes in keloids are equivocal as are the reports of keloid occurring in mucous membranes.

In 244 determinate lesions a success rate of 52 per cent was achieved. Although all of these lesions were clinically termed "keloid," only 53 per cent of those with the pathologist's diagnosis of keloid were successful, as compared with a rate of 83 per cent in those lesions that were termed "doubtful" or "scar" by the pathologist.

Factors that did not influence the result were the location of the lesion, the size, duration before excision, its initiating factor, race, and the presence of other keloidal or nonkeloidal scars. A slightly poorer prognosis is evident when there are other multiple keloids, when there are complaints of pruritis or pain, or when there is a history of recent growth or previous recurrence. However, history of a prior recurrence is not necessarily a contraindication for surgical intervention since the success rate is almost as high as in those primarily treated. In cases in which skin grafting was performed, there was little change in the recurrence rate. However, in 46 per cent of those with a pathologic diagnosis of keloid, keloids developed in the donor site. The use of roentgen therapy in the preoperative and the postoperative period was analyzed. It was found to have little effect except early after operation when some degree of help was noted, although this was not large.

In conclusion, the uncertainties revealed in the literature and the clinical material presented confirm the need for further intensive study of this old and still perplexing problem. —*Carl Schiller.*

Chronic Ulceration and Carcinoma. R. L. Manchanda. *Austral. N. Zealand J. Surg.*, 1961, 30: 233.

Chronic ulcers of several years' duration resulting from extensive burns, surface injuries, or radiation damage were at one time common clinical entities. Today it is less common to see long-standing ulcers. However, the author found 50 chronic ulcers which had been excised in the Plastic Surgery Unit of the Royal Melbourne Hospital, Melbourne, Australia. Of these, 10 showed definite malignant changes and 2 more showed changes suggestive of malignancy. The length of time for which ulceration had been present over 1 year did not appear to be significant and no changes in the epithelium could be regarded as premalignant. The long term danger of radiation is suggested by the fact that in no less than 5 of the cases in this series tumors developed in ulcers which followed roentgenotherapy for benign lesions.

—*W. Foster Montgomery.*

Neoplasms Originating from Pericytes. J. W. F. Beks. *Arch. chir. Neerl.*, 1960, 12: 457.

Pericytes are elliptically shaped cells located immediately outside the basal membrane of the capillaries. Most authorities describe myofibrillas in their protoplasm and regard them as related to the smooth muscle cells of the arteries. Tumors which arise from pericytes are the nearly always benign glomus tumor and the hemangiopericytoma, which is sometimes malignant.

Glomus tumors are enlargements of the structures which form the normal glomus cutaneum and most commonly occur on the extremities, especially under the nails. These neoplasms are small and extremely painful on pressure. They consist of a complex of blood vessels surrounded by epithelioid cells very similar to the cells of the normal glomus. There have been 3 cases of malignant glomus tumor reported; 2 of these had lymph node metastases and 1 had pulmonary and osseous metastases as well.

The capillaries in a hemangiopericytoma have an intact endothelial wall, and the tumor cells surround the blood vessels. Areas of the tumor at a distance from the blood vessels are often necrotic because of insufficient nutrition. The tumor is encapsulated, contains no nerve fibers, and shows marked cellular and nuclear polymorphism. It is exceedingly difficult to present a prognosis on the basis of the histologic findings. Hemangiopericytomas in the thigh and retroperitoneum may be more prone to metastasize, whereas those present from birth are usually benign. Martin and his associates reported local recurrence in 11 and general dissemination in 14 of 70 cases reviewed. Metastases are hematogenous as a rule, and are resistant to roentgenotherapy.

A case of malignant hemangiopericytoma is reported. —*James J. Mongé.*

The Glomus Tumor in Children. Elfriede Kohout and Arthur Purdy Stout. *Cancer*, 1961, 14: 555.

Glomus tumors, although uncommon in children, nevertheless can make their first appearance during the first 15 years of life as the 57 cases collected in this study attest. Although histologically similar to the glomus tumor in adults, the glomus tumor in child-

hood has certain striking differences in distribution and behavior. One striking difference is the greater incidence of multiple tumors in children. Whereas only 16 or 2.3 per cent of 685 glomus tumors starting in adult life were multiple, 15 or 26.3 per cent of the 57 cases starting in children were multiple. Even more striking is the greater incidence of glomus tumors showing infiltrative growth in children. Only 2 patients, 0.3 per cent, with glomus tumors starting in adult life showed infiltrative growth whereas of the 57 patients with tumors starting in childhood, 7 or 12 per cent had infiltrating tumors. Girls are more apt than boys to have subungual tumors whereas the reverse is true of tumors starting elsewhere, a sex distribution that is similar to that of tumors in adults. Subungual tumors are rare in the first 10 years of life. It has not been generally appreciated that glomus tumors can be congenital, but 6 of these 57 children were born with glomus tumors. All of the glomus tumors developing in childhood were found in the external soft tissues of the body or the phalanges, and none was in the viscera or the internal soft tissues.

As in the majority of other varieties of mesenchymal tumors in children, the smallest number of tumors developed in the 5 year period from 6 to 10 years. Glomus tumors can remain in the body for many years, but there is no evidence that any glomus tumor starting in childhood ever became a malignant metastasizing tumor. In the authors' opinion, this also applies to glomus tumors starting in adults for they could not agree that any cases in adults that were reported as malignant glomus tumors were, in fact, glomus tumors. In their opinion, this study, which is part of a general survey of the less common mesenchymal tumors developing in childhood, shows that there are differences between tumors of children and those of adults that are worth knowing if the children are to be treated with intelligence.

—Ely Elliott Lazarus.

Embryonal Rhabdomyosarcoma. Luiz Alberto Fagundes, Moyses Cutin, and Decio Castro. *Arch. Otolar.*, Chic., 1961, 73: 705.

The authors describe 3 cases in which embryonal rhabdomyosarcoma was diagnosed, all of them in children. One patient, who had a mass in the external auditory meatus, was lost to follow-up immediately after biopsy and before any treatment could be instituted. The second patient also had a similar mass and was found to have extensive tumor involvement of the mastoid and middle ear; this child is alive, but has pulmonary metastases after extensive surgical removal and two courses of radiation. The third child had a mass on the side of the neck and pulmonary metastases; no treatment was given and the patient died in 4 months.

The histologic features of these cases were parallel and anastomosing bands of short spindle cells with hyperchromatic nuclei and granular or vacuolated eosinophilic cytoplasm. Cross-striations could be demonstrated with great difficulty in the cytoplasm of these cells in the first and second cases. The fibrils were located at intervals appearing mostly as dots and not traversing the whole width of the cell. No striations could be detected in the third case, which had, in other aspects, histologic features similar to the first 2 cases. At times, in all 3 cases, the neoplastic cells were small and loosened, giving the tumor a myxoma-like appearance. Intermingled with the spindle cells was a variable number of round cells with hyperchromatic nuclei and granular eosinophilic cytoplasm. Occasional giant and multinucleated cells were seen in case 1.

The authors make little comment about the methods of treating this tumor and state only that the principal problem involved is one of recognition.

—John R. Lindsay.

Rhabdomyosarcomas in Childhood. William C. Bailey, William J. Holaday, Stella B. Kontras, and W. William Clatworthy, Jr. *Arch. Surg.*, 1961, 82: 943.

The authors discuss their experience with 14 cases of rhabdomyosarcoma. Three types of tumor on microscopic examination have been described. The pleomorphic type is characterized by pleomorphism, eosinophilic cytoplasm, myofibrils, and occasional cells with cross striations. The alveolar type shows septums radiating from a central vessel, which may be lined by cells having a variable appearance. The third type is embryonal and the predominant cell is the spindle cell. Ten tumors in the present series were of the embryonal types and were located in the bladder neck or prostate, perineum, nose, neck, and shoulder. The alveolar type of tumor was found in the abdominal wall and thigh and the pleomorphic type in the thigh.

These tumors frequently recur after local excision. Some exhibit the characteristic of pseudoencapsulation. The correct histologic diagnosis was made by means of the initial biopsy in only 4 of the 14 cases. The interpretation of the initial biopsy is frequently an inflammatory reaction. In the present series, local excision, radical excision, radiation, and chemotherapy were employed in treatment. Of the 14 patients, 10 are known to be dead, 2 are alive without disease, 1 is alive with metastases, and 1 was lost to follow-up. Five patients have survived more than 18 months. Three of these came from a group of 6 patients whose therapy included radical surgical excision. Radiation and actinomycin D have produced definite though temporary regression in these tumors. The treatment of choice remains radical surgical excision.

—Lloyd D. MacLean.

Hemangiomas in Infants and Children. Lester W. Martin and Donald W. MacCollum. *Am. J. Surg.*, 1961, 101: 571.

The danger of malignant change in hemangiomas is so minimal it is not an indication for treatment. Treatment may be instituted for cosmetic reasons or because of the effect of the lesion on the function of adjacent organs.

Capillary hemangiomas, or "strawberry marks," are the most common type. They are present at birth or appear within a few weeks. Their natural history involves a period of growth of several weeks or months, then a stationary period, and finally a period of spontaneous regression characterized by a grayish film that starts near the center of the lesion and spreads to

the periphery. Regression probably results from thrombosis of feeding arterioles. If ulceration occurs, it is the result of more extensive thrombosis and usually indicates more rapid regression and probably prompt spontaneous healing, rather than being considered a complication or an indication for more aggressive treatment. If a lesion is showing rapid growth, particularly in an area of cosmetic significance, such as the eyelid or lip, the period of growth may be stopped and regression hastened by administering 200 to 300 r of roentgenotherapy. The therapy is regulated to penetrate only to the depth of the lesion. Radium therapy applied in the form of a paste is effective in pure capillary lesions, but does not penetrate into any cavernous element. A 15 to 20 second application of carbon dioxide snow is sometimes painful, but is effective in initiating thrombosis and rapid regression, especially in small lesions.

Surgical excision may be useful in selected cases, but it is more likely to leave a permanent scar than is spontaneous or artificially induced regression. Recurrence may follow if incomplete excision is carried out during the period of growth.

Cavernous hemangiomas are more deeply placed in the subcutaneous tissues, may undergo spontaneous regression, may remain stable in size, or may continue relentless growth making treatment mandatory. Superficial agents such as carbon dioxide snow and radium pastes are unsatisfactory methods of treatment. Injection with any sclerosing agent commonly used in treatment of varicose veins has achieved good results in some cases, but with large lesions in older children, this treatment is often painful and multiple injections may be required. Endothermy coagulation is less popular than in previous years and injury to underlying structures is a possible danger. Roentgenotherapy is a useful method of treatment. Also satisfactory is implantation of gold radon seeds. Surgical excision is reserved for the pedunculated or small, well-demarcated lesion.

Stellate hemangiomas, or spider telangiectases, are best treated by obliterating the central feeder vessel with the electric dessicating needle or a sharp pencil of carbon dioxide snow.

Port-wine stains do not regress spontaneously and respond to no treatment but surgical excision. Cosmetic improvement is the only goal, and in many instances this is better achieved with the cosmetic make-up preparations now available than with excision and skin graft. —*Stanley W. Tuell.*

Histiocytic Tumors, Fibrous Xanthoma and Histiocytoma, in Children. SHIRLEY L. KAUFFMAN and ARTHUR PURDY STOUT. *Cancer*, 1961, 14: 469.

THE RECOGNITION and study of histiocytic tumors in children have been greatly handicapped because their complex and varying composition has been variously interpreted by different observers who have devised names for the tumors depending upon their belief concerning the importance or dominance of the varying cells composing them. When one adds to this the uncertain relationship of some solitary tumors to disturbances of metabolism and to antenatal or familial factors, the confusion becomes still greater. The authors have tried to simplify this confusion by invoking the well established fact that a great many specialized mesenchymal cells are capable of acting as facultative fibroblasts, and the histiocyte is no exception to this rule. Phagocytic histiocytic cells seem to be present in practically all of these tumors whereas capillaries in unusual numbers are found in only a part of them. For the authors it is far easier to believe that these are all tumors of histiocytes in which these cells have exercised their fibroblastic potentialities to a greater or lesser degree, and in which the variable capillary content is not a dominating feature but is perhaps comparable to the capillaries of granulation and scar tissue in which fibroblastic tissue is dominant.

It is obvious from this study of histiocytic tumors in children that the great majority of them are benign tumors that do not exhibit any evidence of biologic malignancy. As in the majority of tumors of all kinds, if excision is incomplete, the portion left behind will continue to grow and result in recurrence. Because relative frequency of mitoses is an indication of possible malignancy in many other varieties of mesenchymal tumors, it was used arbitrarily in the fibrous xanthomas to separate the possibly malignant from the benign.

Although the study of this group of tumors proves that there is a latent malignant potential, this potential must manifest itself with great rarity. Because it exists, however, it is the authors' opinion that all small tumors should be excised with a zone of uninvolved tissue about them instead of just "shelled out." This procedure may be more difficult and leave a slightly larger scar but occasionally it may cure a malignant tumor with a minimum of effort. Even if it does not do that, it may prevent the recurrence of a benign tumor and more extensive scarring because of the necessity of one or more additional operations. —*Ely Elliott Lazarus.*

Grease-Gun Injuries of the Hand. HERBERT H. STARK, JAMES N. WILSON, and JOSEPH H. BOYES. *J. Bone Surg.*, 1961, 43-A: 485.

IN 1941, Mason and Queen gave a detailed description of the tissue changes that follow grease-gun injuries. Damage to the hands is caused by ischemia, chemical irritation, and infection. Sudden distention produces ischemia which, if unrelieved, causes tissue necrosis. Immediate removal of the retained grease decompresses the injured part, lessens the tissue irritation, and rids the wound of contaminated material.

The authors stress the fact that acute grease-gun injuries should be treated as surgical emergencies. From a tiny opening, grease will disseminate through the tissues; it will not necessarily follow anatomic soft-tissue planes. The palm and wrist may be distended with grease that has entered a finger. If the entry is in the midvolar line of a finger, the flexor tendon sheath may be filled with grease or oil throughout its length. Unless the pressure is relieved the tendon will die, even though infection does not supervene. In other closed spaces, such as the pulp of the finger tip, ischemia develops rapidly.

Small incisions over the point of entry are inadequate. All involved parts should be thoroughly explored in a bloodless field. A finger should be opened

through a midlateral incision throughout its length and, if involved, the palm should be opened through an appropriate separate incision. All possible foreign material should be mechanically removed; a blunt curette is the most useful tool. Impregnated, nonessential tissue should be sharply excised. Damaged tendon sheaths should be removed, and only small proximal and middle segment pulleys should be preserved. Even with meticulous care and the utmost patience, some foreign material will still remain. The authors have not used oil solvents, such as ether, because they believe that such solvents are harmful to living tissues, The incisions should be loosely closed, and the hand should be immobilized in a position of function. Tetanus antitoxin or toxoid should be given.

There are excellent illustrations in the article that delineate the effects and treatment of the insidiously vicious grease-gun injury. —*Preston J. Burnham.*

PLASTIC REPAIR

The Treatment of Palpebral Bags. M. González-Ulloa and E. Stevens. *Plastic & Reconstr. Surg.*, 1961, 27: 381.

The cause of palpebral bags is uncertain. If those due to renal and cardiovascular causes are eliminated, there is still a high percentage of cases to which no determined cause can be assigned.

The authors discuss the treatment of adipose palpebral bags, which entails a complicated procedure. They review the history of the problem, the surgical anatomy of the palpebral region, and the causation and pathogenesis of palpebral bags. The productive mechanism is believed to be as follows: (1) increase of the orbital adipose tissue; (2) weakening of the orbital septum; (3) miopragia, atrophy of the orbicular muscle; and (4) distention of the skin.

The operation is carried out by resection of ellipses of skin from both the upper and the lower eyelids. A triangle of skin is also removed lateral to the outer canthus. In this way correction is made to the excess skin, removing simultaneously the wrinkles of the external angle of the lids. Furthermore, they place the eyelid commissure upward and outward, giving the eye a fresh young aspect. An incision is made near the orbital rim in the muscle and septum and, by applying pressure on the ocular globe, the excess fat is projected beyond the limits of the incision and excised. The weakened orbital septum is then strengthened by interrupted sutures of thin catgut and the skin is sutured with No. 6-0 dermalon or silk.

—*Carl Schiller.*

Motor Function in Abbe Flaps. Noel Thompson and A. C. Pollard. *Brit. J. Plast. Surg.*, 1961, 14: 66.

It is generally held that in human subjects muscle cells and free muscle grafts—those which are at the outset wholly detached from the donor site—invariably die or are replaced by fibrous tissue and fail to resume their normal active function. Previous investigators have proved that this is not necessarily so in the Abbe flap, whose only connection with the donor area is a delayed arterial and mucous membrane bridge plus the sympathetic and lymphatic elements in this bridge.

By means of staining techniques and histochemical studies, the authors have demonstrated in the Abbe flap, transferred muscle from the lower lip to the upper lip and its associated mucous membrane and skin, the following findings: (1) As attested to by previous investigators, the muscle of this central flap of the upper lip, once transferred completely, is shown to function visibly. (2) By Koelle's technique cholinestrase was demonstrated, showing that many motor end plates are visible in the transplanted muscle with no obvious numerical reduction in either the transplanted muscle or the control. (3) Sections stained by the hematoxylin and eosin method disclosed that, on the whole, more fibrous and connective tissue was present in the transplanted tissue than in the controls. In some cases the appearances after routine staining of muscle fibers and transplant and control proved virtually indistinguishable even after 5 years. (4) In sections stained by Bodian's technique nerve axons were plentiful throughout the muscle transplants and did not branch before terminating on the muscle fiber but ended in a fine arborization button. Nerve fibers were not shown to enter stained end-plates by the techniques used, but it remained probable that the nerve fibers demonstrated were motor in type. —*Henry S. Patton.*

Variations of the Arterial, Venous, and Capillary Circulation of the Soft Tissues of the Head by Decades as Demonstrated by the Methyl Methacrolate Injection Technique, and Their Application to the Construction of Flaps and Pedicles. Philip F. Corso. *Plastic & Reconstr. Surg.*, 1961, 27: 160.

Methyl methacrolate liquid is injected into the vessels and allowed to harden. After the hardening the soft tissues are digested by potassium hydroxide, which does not affect the methyl methacrolate.

Comparative study of the arterial circulation by decades reveals that the vessels initiate arteriosclerotic changes by an increased tortuosity and this progresses to straight stemlike vessels. The arterial vessels of the areas studied undergo degenerative occlusive changes relative to their age. To consider ambitious flaps in those beyond the seventh decade could be hazardous. The arteries of the subdermal plexuses are the branches of the major perforating arteries arising from the deeper structures and presenting themselves in very predictable anatomic sites. The preservation and incorporation of these major perforators is desirable in the execution of all pedicles and flaps. Furthermore, a definite vascular plane is found directly below the subdermal plexuses of skin. In the skin itself there is a vast network of arterial vessels with a paucity of veins, emphasizing the need for preserving cutaneous veins in flaps.

On the contrary, the venous circulation of the muscles is much greater than their arterial supply. The capacity of the veins of the skin is tremendous and deserves consideration in the treatment of peripheral shock. Arteriovenous shunts of the face can be demonstrated, particularly, in the region of the supratrachlear artery. Other observations are that advanced age with diminished arterial cutaneous circulation does not influence the presence or absence of hair. However, there is definite sparsity of venous circulation in the

nonmuscular area of the tight epicranial aponeurosis. This sparsity may be a causative factor of baldness and it is suggested that relief of the tension of the epicranial aponeurosis by surgery is worthy of further study. —*Carl Schiller.*

BREAST

Reliability of Roentgenologic Diagnosis of Breast Cancer (Ist die Roentgenuntersuchung der Mamma eine zuverlaessige diagnostische Methode?). E. MUNTEAN. *Fortsch. Röentgenstrahl.*, 1961, 94: 509.

ROENTGENOGRAMS OF THE BREAST of 488 patients with mammary disease of various kinds were examined by roentgenologists who knew nothing of the patients' histories or clinical findings. The correct diagnosis was made by the roentgenologist in each of 25 cases in which clinical examination of the patient had revealed an obvious cancer. In 143 of the 488 patients the clinical diagnosis was uncertain, and the breast lesions were biopsied. The roentgenologic diagnosis and the subsequent histologic diagnosis in these 143 patients were as follows: a roentgenologic diagnosis of no cancer and a histologic diagnosis of no cancer in 82 cases, a roentgenologic diagnosis of cancer and a histologic diagnosis of cancer in 48 cases, a roentgenologic diagnosis of suspicion of cancer and a histologic diagnosis of no cancer in 7 cases, and a roentgenologic diagnosis of no cancer and a histologic diagnosis of cancer in 6 cases.

Thus, in those cases in which the clinical diagnosis was in doubt, the roentgenologic diagnosis was accurate in 90.9 per cent. In the author's opinion, this accuracy is sufficient to preclude the necessity for routine biopsy to establish a diagnosis of cancer of the breast. Further, roentgenologic examination of the breast is recommended to screen presumably healthy women for cancer of the breast. Roentgenologic examination of the breast is also suitable for assessing the effectiveness of radiation or hormone therapy of known breast cancers.

The primary roentgenologic characteristic of cancers of the breast is that they are of greater opacity than the surrounding breast tissue. The radiodensity caused by breast cancer usually has irregular borders, although medullary carcinomas may occasionally present smooth margins. Characteristically, the tumor appears much smaller on the roentgenogram than it does to palpation. Stippled calcification in a breast lesion is pathognomonic of cancer, but is found in only a relatively small proportion. Other roentgenologic findings which may help to establish the diagnosis of cancer include retraction of the nipple, which is much more obvious on the roentgenogram than in the patient, thickening of the connective tissue trabeculae near the tumor, thickening of the overlying skin, and increased vascular markings.

Differentiation of cancer of the breast from benign neoplasms is usually not difficult. Benign tumors seem as large on the roentgenogram as they do on palpation. Fibroadenomas cause homogeneous densities which have the same opacity as the connective tissue trabeculae. They are visible only when they are partly or completely surrounded by adipose tissue. Their borders are smooth and sharply defined. The mastopathies, which are always bilateral, are differentiated from cancer by the fact that the lesions of the former appear larger on the roentgenogram than they do by palpation. The prolongations from the roentgenographic densities in mastopathies follow the trabeculae. —*Elmer V. Dahl.*

Detection and Disposal of Breast Cancer in Pregnancy. THADDEUS L. MONTGOMERY. *Am. J. Obst. Gyn.*, 1961, 81: 926.

BREAST CANCER occurring in the pregnant patient is most often a neglected disease, the end results of which are tragic.

Based on a 10 year study of breast cancer in Philadelphia, the author provides the following significant statistical data. 1. One in every 70 breast cancers is detected during a pregnancy or within 6 months after a pregnancy. 2. In women less than 40 years old with breast cancer the incidence of detection during pregnancy was 1 in every 9. 3. The disease was found by the patient in 90 per cent of the cases despite the fact that regular visits were being made for antepartal care. 4. The physician was responsible for delay in diagnosis in 60 per cent of the cases despite the patient's concern. 5. Breast lesions of some significance will be found in 1 in 100 pregnant women and 1 in 10 of these lesions will be cancer.

It is recommended that breast examination be carried out at each antepartal visit and that all suggestive lesions be biopsied under local anesthesia. If a histologic diagnosis of cancer is made, the pregnancy should be terminated. Roentgenotherapy to the breast should precede definitive operation.

—*M. Leon Tancer.*

Simplified Treatment of Cancer of the Breast. GEORGE CRILE, JR. *Ann. Surg.*, 1961, 153: 745.

DATA are presented to support less radical rather than more radical operations for the treatment of cancer of the breast. Beginning in January 1955 approximately one half of the patients at the Cleveland Clinic, Cleveland, Ohio underwent simple mastectomy usually without radiation as a standard treatment for cancer of the breast. The other one half of the patients were treated by means of conventional radical operations often with postoperative radiation. The disease was staged as follows: stage 1—disease apparently limited to the breast, stage 2—positive axillary nodes, stage 3—fixed axillary nodes, and stage 4—distant metastasis.

In the simple mastectomy series, stage 1 lesions were treated with simple mastectomy. In selected patients with very small peripheral lesions, nothing but a wide quadrant excision or hemimastectomy was performed, 13 per cent. The flaps were made short and thick. All wounds were closed primarily without grafting. Cobalt 60 teletherapy was given after operation in only 25 per cent of cases. Patients with stage 2 cancer were treated with simple mastectomy followed by cobalt 60 teletherapy for the axillary nodes. For stage 3 lesions, occasionally simple mastectomy and radiation were used with or without endocrine therapy or chemotherapy. When operation was not performed, the diagnosis was confirmed by needle biopsy. Stage 4 cancers were treated by combinations of endocrine

therapy, radiation, and chemotherapy. The diagnosis was confirmed by means of needle biopsy in these patients as well.

No apparent difference in 3 year survival existed between 1953 and 1954 when only 12 per cent of the patients were treated by simple mastectomy and 1957 when 73 per cent of the patients were treated by simple mastectomy. Follow-up studies showed that the 3 year survival in the former group of patients was 70 to 75 per cent, and in the latter group it proved to be 79 per cent.

Controlled clinical studies are urgently needed to determine what treatment in each stage of breast cancer will produce the highest survival rate with the lowest morbidity. It is suggested by the author that simple mastectomy without prophylactic radiation is at least as effective as radical mastectomy with or without radiation. It is further suggested that patients with clinical stage 1 cancer who are treated by simple mastectomy without radiation and in whom positive axillary nodes later develop should then undergo axillary dissection. It is believed that their chances for survival will not be jeopardized by this manner of treatment. In favorable clinical stage 2 cancers, modified radical mastectomy with preservation of the muscles is advised in preference to the classical radical mastectomy followed by radiation therapy. In the experience presented, this form of therapy caused less disability than conventional radical operations and was less cumbersome than simple mastectomy and irradiation. —*Lloyd D. MacLean.*

Blood Corticosteroid Levels in Mastopathy and Breast Cancer After ACTH Administration (Der Corticosteroidspiegel des Blutes bei Mastopathie und Brustkrebs unter ACTH-Belastung). KURT SCHUBERT, GIOVANNI BACIGALUPO, and GUDRUN FRANKENBERG. *Arch. Geschwulstforsch*., 1961, 17: 108.

PREVIOUS STUDIES in patients with breast cancer reported by the authors demonstrated derangements of steroid metabolism. The functional relationship of the adrenal gland to breast cancer was documented by the postadrenalectomy changes found in advanced breast cancer.

The 5-corticosteroids in the blood were determined hourly for 5 hours after intravenous infusion of 3 units of ACTH in the following groups of patients: 4 healthy females; 15 patients with fibrocystic disease, 4 of whom had breast cancer; and 10 patients with breast cancer. The average ratio of preinjection to 5 hour blood levels was determined. The average values in patients with fibrocystic disease and stage I and II breast carcinomas were higher than in normals. The patients with stage IV breast cancers showed ratios similar to the control patients, but their preinjection 5-corticosteroid levels were characteristically elevated. The initial urinary corticoid excretion, tetrahydroderivatives of cortisone and hydrocortisone, in general, was in direct proportion to the blood level. In 2 patients with fibrocystic disease of the breast associated with cancer, however, low plasma levels were found to be associated with high urinary excretion. —*Karel B. Absolon.*

SURGERY OF THE THORAX

CHEST WALL

Operative Treatment of Congenital Deformities of the Chest. MARK M. RAVITCH. *Am. J. Surg.*, 1961, 101: 588.

FAILURE of the paired sternal anlagen to meet and fuse properly in the ninth week of fetal life results in partial or complete congenital sternal cleft. Simple complete separation without significant displacement of the heart is readily correctible by operation, particularly if undertaken within a few days after birth. The greater the degree of anterior displacement of the heart, the less amenable is the defect to surgical correction. Complete ectopia cordis, with no skin covering the displaced heart, has not been successfully repaired.

V-shaped clefts of the upper sternum can be repaired in early infancy. If cardiac displacement is present, it is usually anterior rather than cephalad, despite the commonly used term, "cervical ectopia cordis." Repair in early infancy is important, since it usually eliminates the need for the relaxing chordotomy and the foreign material prosthesis sometimes required a few months or years later when rib cage elasticity becomes less.

Inverted V-shaped clefts of the lower sternum are usually associated with a defect in the anterior abdominal wall musculature, a defect in the anterior attachment of the diaphragm, protrusion of the heart anteriorly, and an intracardiac septal defect. All but the last defect are best attacked by operation in the neonatal period, with strong fascial reinforcement of the lower sternum rather than actual sternal approximation being satisfactory.

Congenital absence of ribs is best corrected by bridging the defects with slender rib struts made from a rib excised from the opposite side. Associated deformities are usually present and early operation is preferable.

Pectus excavatum and protrusion deformity, or pigeon breast, are often considered asymptomatic in infants and children. However, both of these ailments tend to become clinically and symptomatically worse as age increases, and apparently by distorting or decreasing thoracic space cause respiratory and cardiac dysfunction. Surgical correction may be successful at any age but it is easier for both surgeon and patient if performed in childhood or infancy. Either deformity is corrected by exercising the deformed costal cartilages and reshaping the sternum with one or two transverse osteotomies across the upper or midsternum. A transverse strut made from a rib may be used beneath the sternum. External traction is not necessary. —*Stanley W. Tuell.*

Mondor's Disease—Superficial Phlebitis of the Chest Wall. CHARLES HONIG and RICHARD RADO. *Ann. Surg.*, 1961, 153: 589.

MONDOR'S DISEASE consists of a phlebitis and periphlebitis of the lateral thoracic or thoracoepigastric vein. Originally described by Flagge in 1869, it takes its name from a French surgeon, Henri Mondor, who in 1939 described the disease as a "string phlebitis of the chest wall." Characteristically there is a tender, fibrous cord fixed to the skin and forming a furrow, which is usually below the level of the nipple but may be located anywhere between the anterior axillary line and the epigastrium. If cut, the cord will snap and retract like a rubber band.

The condition is seen twice as frequently in women as in men. Although it is reported to occur more frequently on the left side of the chest, there was almost equal distribution in the 7 cases reported in this series. In 3 cases the disease followed breast biopsy, 1 followed shaving of the axilla, 2 followed trauma, and 1 appeared postpartum. The disease is self limiting and in all 7 cases the condition cleared up without any treatment other than the application of warm compresses.

Up till 1957 only 65 cases had been reported in the world literature, but the authors believe that it occurs much more frequently than such figures would indicate. Its recognition is of importance because of the occasional confusion with carcinoma of the breast.

—*George R. Holswade.*

Management of Tumors of the Thoracic Parietes. ELTON WATKINS, JR., and FRANKLYN P. GERARD. *Surg. Clin. N. America*, 1961, 41: 645.

A REPORT is made of 36 patients with malignant tumors involving the chest wall. These tumors included chondrosarcoma, malignant melanoma, neurogenic fibrosarcoma, somatic and undifferentiated sarcoma, mesothelioma, metastatic adenocarcinoma, and other rarer forms of malignancy. The commonest initial complaint of these patients was the presence of a painless mass on the thoracic wall. Pain was the initial complaint in 13 patients. Other complaints included shortness of breath and cough.

Histologic examination is recommended at some time during the therapy of the tumor mass. Whether the microscopic diagnosis was established by the study of an incisional biopsy specimen or by examination after an en bloc excision of the lesion was governed by: (1) the size of the lesion and (2) the general physical condition of the patient. Needle aspiration biopsy was not satisfactory.

A wide en bloc excision of the growth with a generous margin of normal tissue on all sides is essential for the success of the operation even though total excision requires the removal of a number of ribs or costal cartilages, or of the sternum. When wide segments of the thoracic wall are removed, restoration of the integrity can be accomplished by means of periosteal strips or bone grafts. In the absence of distant metastases, surgical excision without irradiation was the primary form of treatment. Postoperative radiation therapy was reserved for those cases in which excision was incomplete because of extension into the vertebral canal or other vital area. Even when re-

currences were noted a number of times, re-excision was attempted before radiation was employed as the primary method of treatment.

Of the 36 patients whose cases were reported, 22 were known to have died at the time of report. Twenty of the 22 deaths were caused by extension of the disease.

—*Lloyd D. MacLean.*

TRACHEA, LUNGS, AND PLEURA

Study of Bronchial Peristalsis (Esiste una peristalsi bronchiale?). D. Gandini, G. Juliani, and E. Petterino. *Radiol. med.*, Milano, 1961, 47:97.

The subject of a peristaltic bronchial motility has never been settled because of technical difficulties in the investigative methods previously employed. This study on 20 adult patients, free from respiratory diseases, confirms the findings of previous experimental work by the same authors. The results would seem to exclude the existence of "bronchial peristalsis." There exists an active bronchial motility linked to the function of the intrinsic smooth muscles. This motility is independent of respiratory, esophageal, or cardiovascular movements. It plays perhaps an important role in the regulation of regional ventilation, participating in the mechanism of compensation in pathologic states. The active bronchial motility may, moreover, be capable of modifying the respiratory motility and of making the expulsive stage of the cough more efficacious.

The method used by the authors at the Institute of Radiology of the University of Turin Medical School, Italy, consisted of performing a thin layer bronchography in adults under general anesthesia. To abolish the costodiaphragmatic motility, the subjects were treated with succinylcholine chloride. In this fashion, the tracheobronchial tree could be investigated in complete apnea for 50 to 60 seconds with continuous kymographic registrations. —*Michele A. Chiechi.*

The Circulation of the Primary Lobule of the Lung. K. K. Pump. *Dis. Chest*, 1961, 39: 614.

Normal human lungs obtained at necropsy were rinsed with physiologic saline solution by cannulating the pulmonary artery. Fluid was removed by forcing it out through the pulmonary vein after which the pulmonary artery was injected with blue vultex moulage. Red vultex moulage was used for injection of the pulmonary vein and the bronchial tree was injected with white moulage. Hydrochloric acid digestion was then utilized and several pieces were studied with the dissection microscope.

Dissection revealed that there was a close relationship between the pulmonary artery and the bronchial tree throughout its subdivisions. These dissections, however, revealed that this relationship is discontinued when the pulmonary arteriole reaches the alveolar duct of the primary lobule. At this point the arteriole breaks up into precapillaries, which after travelling a short distance break up into capillaries and form a network over the alveolus. Distal to the alveolar duct of the primary lobule there are no further vessels that can be identified as subdivisions of the pulmonary artery except the capillary network of the alveoli. A capillary network is not necessarily confined to one alveolus but continues on from one alveolus to another. The capillaries of the network measure less than 0.014 mm. in diameter, implying that every red blood cell passing through these capillaries has at least one side exposed directly to the alveolar surface. —*Allan D. Callow.*

Roentgenologic Aspects of Chronic Cor Pulmonale (Aspetti radiologici del cuore polmonare cronico). F. Camerini and F. Manfredi. *Radiol. med.*, Milano, 1961, 47:114.

The roentgenologic changes occurring in 33 cases of chronic cor pulmonale are the subject of this work from the United Hospitals, Trieste, Italy. The authors have studied the changes pertinent to the heart and the pulmonary circulation in three evolutive stages of the disease, that is, the stage of compensation, the stage of heart failure, and the stage of recompensation. Of the 33 patients, all with emphysema and/or chronic bronchitis, 11 died. Autopsy was performed in 5 cases and it revealed in all right ventricular hypertrophy and dilatation, chronic bronchitis, and emphysema.

The roentgenologic picture of compensated chronic cor pulmonale is essentially that reported in the literature by many investigators. In addition to the variation of the cardiac silhouette, the failing chronic cor pulmonale presents marked changes of the arterial and venous pulmonary vessels. These changes have not received proper attention in recent studies. They consist of enlargement and crowding of the hilar shadows; the vessels have hazy contours and are difficult to recognize because of the state of congestion that obliterates the parenchyma between vessels; the pulmonary fields are gray and cloudy as a result of slight interstitial edema. These changes result from the combination of two roentgenologic syndromes, that due to pulmonary arterial hypertension and that due to pulmonary venous hypertension. The pulmonary congestion is readily detectable not only at the hilar regions but also in the midlung fields in which a reticular pattern is often present. All these modifications tend to decrease and even to disappear in the stage of recovery although some degree of congestion may still be noted. Unusual points in chronic cor pulmonale are the infrequency of pleural effusions —2 cases in the present series—and the almost total absence of alveolar pulmonary edema.

—*Michele A. Chiechi.*

Management of Nontuberculous Empyema. Elton Watkins, Jr., and Charles R. Fielder. *Surg. Clin. N. America*, 1961, 41: 681.

The old surgical truism that large accumulations of purulent fluid must be drained surgically is as true for pus in the pleural space as it is for purulent accumulations elsewhere in the body. All evidence indicates that the pleural membrane equals the peritoneum in its ability to handle infection. The authors deal with the diagnostic procedures available and enumerate the results of the various diagnostic studies. Their study encompasses a period from 1924 to 1958 and includes 122 cases.

The principles of treatment of empyema are outlined as follows: (1) The early completion of diag-

nostic studies sufficient to establish the extent of the empyema, its cause, and the exclusion of distant systemic disease; (2) the early performance of needle thoracentesis for purposes of obtaining fluid for antibiotic studies; and (3) vigorous prosecution of adequate pleural drainage at the earliest possible moment to minimize prolonged debility and the necessity for major operations to obliterate large pockets of chronic empyema.

The treatment of empyema is resolved into an initial phase and a phase of rehabilitation. A chart is presented which outlines the salient features of systemic care and local surgical treatment during each of these phases.

Despite an increase in the incidence of empyema secondary to major thoracic operations after 1940, the mortality rate has improved and the duration of hospital stay has been shortened. There has been only a slight change in the bacterial flora observed in cases of empyema in the period before and that after 1940.

—*Gordon F. Madding.*

Incidence and Prognostic Significance of Blood Vessel Invasion in Bronchial Carcinoma (Frequenza e significato prognostico dell'invasione vascolare nel carcinoma bronchiale). G. Maggi and M. Gnavi. *Cancro*, Tor., 1960, 13: 487.

After a review of the pertinent literature, the authors report on their investigation of the incidence of invasion of blood vessels in 125 patients with bronchogenic carcinoma operated upon at the Institute of Surgical Pathology of the University of Turin Medical School, Italy, in the period 1951 to 1958. In each case, multiple sections were taken from the tumor mass, at the apparent boundary line of the tumor and at some distance from it in the lung parenchyma. A study of the survival rate in the two groups of patients, the one with and the one without invasion of blood vessels, is also reported.

Invasion of the blood vessels was present in 51 per cent of the cases, with the lowest incidence, 45 per cent, in the squamous group and the highest, 60 per cent, in the anaplastic group. A 60 per cent incidence of vascular invasion was found in the peripheral and parahilar tumors, whereas the hilar tumors invaded the blood vessels in 42 per cent of the cases.

The finding of blood vessel involvement has an important prognostic bearing. At the end of the fourth year after operation, 2 per cent of the 64 patients with positive findings and 18 per cent of the patients with negative findings were alive. —*Michele A. Chiechi.*

Lung Cancer Among Indians of the Southwestern United States. Maurice L. Sievera and Samuel L. Cohen. *Ann. Int. M.*, 1961, 54: 912.

There were 12,511 patients, 8,287 of whom were adults, admitted to the Phoenix Indian Hospital, Phoenix, Arizona from 1954 through 1960 out of an estimated regional population of 76,310 Indians. Females slightly outnumbered males. No case of primary lung cancer was detected in this group nor found in 50,000 roentgenograms of the Indians in this period.

In Caucasians it is estimated that there would have been a death rate from lung cancer of 16.6 per 100,000 nonsmokers and of 158.8 per 100,000 for smokers over 55 years of age.

It is not known whether hereditary or environmental factors are related to this deficit. However, minimal exposure to industrial fumes and infrequent use of cigarettes among the Indian population may be noteworthy findings. Further investigation is required to determine the conditions of significance in the deficiency of lung cancer among Indians of this area.

—*James S. Conant.*

Carcinoma of the Lung. William P. Quinn, Durand Leonard, and Beauvoir Edmond. *J. Nat. M. Ass.*, 1961, 53: 257.

The authors present a statistical report and philosophical analysis of the trends in the increase in lung cancer as seen in the Provident Hospital, Chicago, Illinois, over a span of 30 years. The beginning, 1931 to 1940, and ending, 1951 to 1960, decades of the period are reviewed. The hospital described is strategically located in the geographic center of an area known as the Central South Side of Chicago, which encompasses four square miles with a population of 277,731 according to the census of 1940. The average population density for the city as a whole was 27,000 per square mile, but for the Central South Side the density was 51,100 persons per square mile of which only 4,000 were non-Negro. It has previously been stated that the poorest economic class has a 40 per cent higher incidence of lung cancer than the remaining population.

In the 10 year period 1931 to 1940, total hospital admissions rose from 2,700 in 1931 to 4,500 in 1940 for a total of 37,250 hospital admissions during the decade. The incidence of carcinoma of the lung during this period remained low. The incidence was 2.1 per cent for all malignant lesions and 0.03 per cent of all admissions. In the period 1940 to 1944 only 2 cases of proved cancer of the lung were recorded. In the period 1946 to 1950, however, 17 proved cases were presented, of which 8 were in female patients. In the 10 years from 1951 to 1960, primary carcinoma of the lung represented 0.044 per cent of all admissions as compared with 0.02 per cent in 1931 to 1940. In 1931 to 1940 there were 11 cases of cancer of the lung which comprised 2.1 per cent of the 504 cases of proved malignancy, and in the 1951 to 1960 period there were 43 cases of cancer of the lung comprising 4.2 per cent of the 1,023 cases of proved malignancy.

The authors then interpolate these data to demonstrate the relative magnitude of carcinoma of the lung. They calculate that their hospital of 205 beds supplied 5.4 per cent of the total beds needed in the Chicago South Side area in 1940. The 504 proved malignant lesions in their hospital would indicate 9,274 cases of malignancy in the Central South Side area in the 1931 to 1940 decade. Of these, 2.1 per cent or 185 cases would be carcinoma of the lung. In the decade 1951 to 1960, the Provident Hospital had 89,693 admissions of which 1,023 or 1.14 per cent were due to malignancy. The population of the area is now 750,000 to 1,000,000 and the number of malignant lesions is projected to 51,150 of which 2,148 or 4.2 per cent would be carcinoma of the lung in the 10 year period 1951 to 1960.

The population rise of the 30 year period is 4 to 1. The rise in over-all malignancy is 1.2 to 1. The incidence of lung cancer has risen to 5 to 1 in the Central South Side area in the over-all 30 year period.

—*Donald M. Clough.*

Result of 119 Operations for Bronchopulmonary Cancer (Bilan de 119 interventions pour cancers bronchopulmonaires). E. NÈGRE, H. PUJOL, and A. THÉVENET. *Ann. chir.*, Par., 1961, 15: 549.

THE RESULTS of 73 resections and 46 exploratory thoracotomies performed by a single team with the same operator are presented. Long term results are stressed. The group of nonresectable tumors represented a little more than one-third of the cases in which operative intervention was indicated, 38.5 per cent against 61.5 per cent. Of 46 exploratory thoracotomies 5 or 11 per cent were followed by death in the first month, a rate not considerably lower than that found for resections, 16 per cent. Sequelae to such thoracotomies are uncomfortable for the patient. Survival is short and little influenced by postoperative roentgenotherapy. Unwarranted exploratory procedures are decried. For these authors prescalene node biopsy has only limited value as a criterion for operation. In cases of clinically evolved cancer 21 biopsies yielded only 4 positive results—3 anaplastic epitheliomas and 1 malpighian epithelioma.

Of the 73 resected cancers 6 were in women. The mean age of the group at operation was 50 to 60 years. The operative mortality, death in the first month, was 16.3 per cent. There were 12 deaths. Types of operation included 50 pneumonectomies, 20 lobectomies, 1 segmentectomy, and 2 procedures to remove metastatic tumor deposits. Histologic breakdown of tumor material indicated 43 epitheliomas, epidermoid; 43 malpighian epitheliomas; 11 anaplastic or undifferentiated epitheliomas, 8 small cell and 3 large cell; 18 adenocarcinomas; and 1 reticulosarcoma.

In respect of long term follow-up results of 41 patients resected for 4 years or more, one-third or 14 remain alive without recurrence. The authors note that right pneumonectomy, which gives an immediately higher postoperative mortality than left pneumonectomy, gives better long term results than does left pneumonectomy. From the point of view of prognosis over prolonged periods malpighian and peripheral tumors yield best results. —*Stacey B. Day.*

Pulmonary Resection in Infancy and Childhood. JOHN H. FOSTER, J. KENNETH JACOBS, and ROLLIN A. DANIEL. *Ann. Surg.*, 1961, 153: 658.

THIS IS an analysis of 55 children and infants who underwent pulmonary resection between the years 1945 and 1959. Operation was performed for congenital anomaly in 5 cases, for pulmonary tuberculosis in 11 cases, for chronic infection in 16, and for bronchiectasis in 23 instances. The extent of the resection varied. In only 5 cases was pneumonectomy performed. In the majority of cases the left lower lobe and/or lingula was resected.

Operative complications were recorded in approximately 10 per cent of the patients. There was only 1 death out of the 55 cases, with a rate of 1.7 per cent. This single death was the result of cardiac arrest.

Follow-up was carried out in approximately 90 per cent of the cases. The majority had good to excellent clinical results. The patients who underwent resection for congenital anomalies all had excellent results. Results were uniformly good in those patients who had resection for tuberculosis.

There was some decrease in pulmonary function in all the patients. Exercise tolerance was often normal even though the vital capacity and maximum breathing capacity were diminished.

—*Richard L. Lawton.*

HEART AND PERICARDIUM

The Limitations of Present Techniques in the Precise Diagnosis of Interatrial Septal Defects and Description of an Experimental Method of Visualization. DUNCAN A. KILLEN, EDWARD M. LANCE, and JESSE E. ADAMS. *J. Thorac. Cardiovasc. Surg.*, 1961, 41: 643.

THE DIAGNOSTIC EFFICIENCY of cardiac catheterization and angiocardiography in the diagnosis of interatrial septal defect is evaluated and an experimental method of angiocardiography, impedance atriography, is described which is designed to permit the accurate diagnosis and detailed anatomic description of interatrial septal defect.

A series of 52 patients is presented, all of whom have had a diagnosis of interatrial septal defect on the basis of cardiac catheterization or angiocardiography. Of the entire group, 49 patients underwent cardiac catheterization with unequivocal demonstration of an interatrial septal defect in 18, 36.7 per cent, on the basis of passage of the catheter directly from the right to the left atrium. Eleven of the 52 patients were subjected to angiocardiography with 6 having unequivocal evidence of an interatrial septal defect on the basis of either defect in visualization or consecutive opacification of the injected and noninjected atria. The combined diagnostic efficiency of both procedures was such that an unequivocal diagnosis of interatrial septal defect could be made in only 40.4 per cent.

Twenty-eight patients, 53.8 per cent, had the clinical diagnosis of interatrial septal defect supported only by the presumptive evidence of (1) increased oxygen saturation of blood of the right atrium, (2) abnormal appearance of nitrous oxide or indicator dye in blood of the right atrium, or (3) prolonged opacification of the right side of the heart by contrast medium. These presumptive signs may be the basis for a false diagnosis of interatrial septal defect.

An evaluation of balloon tamponade of the main pulmonary artery is presented as a means of increasing the diagnostic potential of angiocardiography of the right side of the heart.

Ten dogs were subjected to creation of an interatrial septal defect. Each dog had a control series of angiograms without pulmonary artery tamponade, after which impedance atriography was accomplished by means of injection of contrast material into the right atrium after pulmonary artery occlusion varying from 0 to 10 seconds with a balloon catheter.

In neither group of animals did the control roentgenograms demonstrate the presence of a defect, whereas impedance atriography produced angiocardiograms diagnostic of interatrial septal defect in

each animal tested at the time of operation after an interatrial septal defect had been made.

It is believed that the clinical applicability of impedance atriography seems highly possible, in that catheterization of the pulmonary artery with a balloon catheter is readily accomplished in most people and the risk is little except in those with an abnormally high output of the right side of the heart.

—*Patrick F. Jewell.*

New Approaches to Coronary Arteriography. GOFFREDO G. GENSINI, SALVATORE DI GIORGI, and ASHER BLACK. *Angiology*, 1961, 12: 223.

THE AUTHORS report their search for a safe, accurate, reproducible method for coronary arteriography. A plastic catheter is introduced under local anesthesia by means of percutaneous puncture of the femoral artery and advanced with fluoroscopic control to the bulb of the aorta and at the level of the sinuses of Valsalva. Cardiac diastole is prolonged while the contrast material is being injected and serial roentgenograms are made during the artificially prolonged diastole and the normal systole that follows. Acetylcholine is used to prolong diastole. A 10 c.c. syringe driven by a spring-loaded mechanism released in diastole by the patient's R wave is used for the injection of diatrizoate methylglucamine. A polyethylene tube 112 cm. in length is introduced. No major complications have been encountered and minor complications have been limited to small occasional hematomas at the site of puncture. In 2 cases the procedure had to be discontinued because of extreme tortuosity of the iliac vessels. —*Allan D. Callow.*

Percutaneous Catheterization of the Aorta. EDWARD I. HENRY, LESLIE A. KUHN, LEONARD STEINFELD, and ALVIN J. GORDON. *J. Mount Sinai Hosp.*, N. York, 1961, 28: 283.

ALTHOUGH individual diagnostic procedures utilizing the passage of a catheter into the aorta are often performed, the full potential of aortic catheterization is not often realized. It is the purpose of this communication to emphasize the uses of the catheter as a probe, for recording of pressures, for the purpose of injecting dye during indicator dilution studies, and for sampling of blood for oxygen analysis. All modalities in common use in catheterization of the right side of the heart are equally applicable to aortic catheterization. Furthermore, many of these studies may be performed percutaneously, with avoidance of technical difficulties and complication of arterial exposure and incision.

At the Mt. Sinai Hospital, New York City, the authors use radiopaque polyethylene tubing in a modification of the Seldinger technique. The flexible metal-tipped leader increases maneuverability for positioning. Dye dilution studies employ the Colson densitometer and constant-flow syringe.

Three clinically similar cases with left to right shunts are presented which demonstrate the variety of methods available for diagnosis of these lesions during catheterization of the aorta. All were suggestive of uncomplicated patent ductus arteriosus. The final diagnoses were aortic pulmonary windows, rupture of aneurysm of the sinus of Valsalva, and a very large patent ductus arteriosus.

The technical details of these diagnostic measures are well described. —*James S. Conant.*

Rupture of the Thoracic Aorta Due to Nonpenetrating Trauma. ROBERT P. MCBURNEY and ROBERT H. VAUGHAN. *Ann. Surg.*, 1961, 153: 670.

THIS ARTICLE deals with 6 cases of rupture of the aorta after nonpenetrating trauma.

There seems to be an increasing frequency of rupture of the thoracic aorta, probably resulting from the increasing number of people involved in automobile and airplane accidents.

Experimental work has shown that the aorta will tolerate internal pressures of over 3,000 mm. Hg. It has been postulated that the mechanism of rupture is differences in deceleration rates between parts that are relatively fixed and those that are mobile. The extent of the ruptures may vary from complete to somewhat insignificant ones of the intima.

It is of interest that most of the patients survive over 8 hours after the nonpenetrating trauma. A combination of symptoms and signs which include hemothorax, mediastinal enlargement, dysphagia, and hoarseness, should make one suspicious of this diagnosis.

Once the diagnosis is made, the treatment is surgical. The technique described for aortic resection includes a local shunt from left subclavian to distal aorta. This latter method is the simplest and most available method for maintaining circulation in the distal aortic distribution. In cases of elective resection of an aneurysm, cardiopulmonary bypass should be initiated. —*Richard L. Lawton.*

Coarctation of the Aorta. ARTHUR DEBOER, LUIS GRANA, WILLIS J. POTTS, and MAURICE LEV. *Arch. Surg.*, 1961, 82: 801.

A STUDY of the pathologic, clinical, and surgical data from 135 cases of coarctation of the aorta at the Children's Memorial Hospital, Chicago, Illinois would seem to indicate that there are four types of coarctation complexes that have surgical importance. (1) The fetal coarctation complex consists of a wide nonconstricting coarcted area associated with pulmonary hypertension, right ventricular hypertrophy, and a small left side with hypoplasia of the ascending aorta. (2) The adult type of coarctation consists of constrictive lesions in the region of the ductus arteriosus associated with left ventricular hypertrophy. (3) The converted adult type of coarctation consists of a wide lesion similar to that seen in the fetal type, but with a constricting lesion. (4) The transitional coarctation is a wide constricting lesion that is associated with pulmonary hypertension and bilateral ventricular hypertrophy.

The concept is advanced that some children born with fetal coarctation die early in life, whereas others survive long enough for a truly constricting lesion to develop and they die in the transitional stage. Others survive and go on to have a constrictive lesion which is termed "converted adult coarctation."

A suggested, but as yet untried, method of treatment for the infantile coarctation may be a slow obliteration of a widely patent ductus arteriosus which would promote a natural transition from fetal

to adult coarctation. Treatment of the infantile type of coarctation by simple acute ligation of the ductus or by means of bypassing the coarctation with a graft did not prove successful.

There were 3 deaths in the series of 100 patients with adult type of coarctation treated surgically, and in these cases there were additional serious complicating conditions which contributed heavily to the deaths. —*George R. Holswade.*

Ten Years' Experience with Penetrating Injuries of the Heart. VOLLRAD J. VON BERG, LUIGI MOGGI, LYLE F. JACOBSON, PRESCOTT JORDAN, JR., and CHARLES G. JOHNSTON. *J. Trauma*, 1961, 1: 186.

THE CASE HISTORIES of 102 patients with penetrating wounds of the heart who were alive on admission to the City of Detroit Receiving Hospital during a 10 year period, 1949 to 1958, were reviewed. The overall survival rate was 87 per cent.

Of the 92 patients subjected to operation 39 had right ventricular intraluminal injury, 37 had left ventricular penetration, 6 had right auricular injuries, 6 left auricular injuries, 1 laceration of the pulmonary artery, and 1 an ice pick wound of the aorta. In 5 cases nonpenetrating myocardial lacerations were encountered, and pericardial lacerations without cardiac injury occurred in 3 patients. In general ice pick wounds respond to aspiration and rarely reform a hemopericardium.

In this series operative treatment was the method of choice and only 8 patients were treated by aspiration of the pericardium alone. The mortality rate was exactly the same, 13 per cent, for both the operative and nonoperative groups. The authors found that many patients in this series did not have tamponade, but were in shock due to extensive hemorrhage into the pleural space. Of the operated upon patients 65 per cent presented active cardiac bleeding which in the surgeon's opinion probably would not have stopped spontaneously. —*George R. Holswade.*

Atresia of the Mitral Valve. S. FRANK REDO, SIDNEY FARBER, and ROBERT E. GROSS. *Arch. Surg.*, 1961, 82: 696.

THIS IS A REPORT on 19 cases of atresia of the mitral valve seen over a 30 year period. All of the cases are tabulated, and pertinent data are recorded. The hemodynamics involved are recorded in chart form. Of all the cases reported, 3 patients were operated upon and 1 survived.

The preoperative diagnosis is seldom made. Survival with this lesion is a matter of days, weeks, or months, as a rule. One patient survived 17 years.

Prominent symptoms are cyanosis and dyspnea. Roentgenographically there is an enlarged heart with an abnormal configuration.

Postmortem examination in the majority of these cases revealed a multiplicity of cardiac defects. About one-third of the patients had associated noncardiac defects.

The 1 patient, an 8 year old boy who was successfully operated upon, had survived approximately 6 months at the time the report was made. At the time of operation his right atrium was explored and a small left to right shunt was noted in the interatrial septum. This shunt was enlarged, relieving some of the tension on the pulmonary circuit.

The authors attempt to correlate the major cardiac anomaly with the multiplicity of other cardiac anomalies found. —*Richard L. Lawton.*

Congenital Corrected Transposition of the Great Vessels: A Study of 33 Cases. GEROLD L. SCHIEBLER, JESSE E. EDWARDS, HOWARD B. BURCHELL, JAMES W. DUSHANE, and Others. *Pediatrics*, 1961, 27: 851.

THE AUTHORS analyzed the records of 33 patients—64 per cent males—with corrected transposition of the great vessels: 31 in situs solitus, and 2 in situs inversus. Diagnosis was confirmed by necropsy or operation in 18 cases. No patient had a family history of congenital heart disease.

The person whose only anomaly is corrected transposition has no hemodynamic basis for symptoms. Symptoms are the result of associated lesions, the most common of which are anomalies of the left atrioventricular valve usually causing incompetence, ventricular septal defects, pulmonary valvular stenosis, and advanced disturbances of atrioventricular conduction. Physical findings in corrected transposition depend upon these associated defects. Associated noncardiac anomalies are rare.

Anteroposterior thoracic roentgenograms may suggest the diagnosis, particularly when a "narrow waist" at the base of the heart is present, the pulmonary-artery "knob" absent, and the left atrium enlarged.

Electrocardiographic features suggesting corrected transposition are atrioventricular block, particularly 2 to 1 or complete heart block; abnormal P waves; absent or low R voltage in aVR; an initial Q wave in leads 3, aVR, aVF, and V_1; absence of a Q wave in lead V_6; upright T waves across the precordium in children; and a clockwise spatial loop in the frontal plane.

Cardiac catheterization may be diagnostic when the location of the atrioventricular valves, their relation to the semilunar valves, and the position of the great vessels in the anteroposterior and lateral views are carefully documented. Inability to enter the pulmonary artery during catheterization should arouse suspicion; in these cases angiocardiography is particularly useful.

To decide whether the most frequently associated malformations exist as isolated entities, or are present in combination with corrected transposition, is one of the main differential problems. Another is the differentiation of corrected transposition with associated cyanosis from uncorrected transposition.

Complete atrioventricular block before or after operation, residual left atrioventricular incompetence, and the mirror-image arrangement of the coronary arteries often were responsible for technical difficulties of operation and for postoperative complications.

Sixteen patients died. The most common cause of death was cardiac failure, often with terminal pulmonary edema. The average age at death in this series was 14 years, with a median age of 4 years.

A review of the literature emphasized the association of corrected transposition with some degree of atrioventricular block. The most frequently reported

associated cardiac lesions were ventricular septal defect, pulmonary stenosis or atresia, patent ductus arteriosus and dextrocardia. The incidence of anomalies of the left atrioventricular valve in reported cases has probably been underestimated.

Complete Correction of Tetralogy of Fallot. FRANK GERBODE, J. BRUCE JOHNSTON, ALBERT A. SADER, WILLIAM J. KERTH, and JOHN J. OSBORN. *Arch. Surg.*, 1961, 82: 793.

THE EXPERIENCE obtained in the total correction of tetralogy of Fallot in 66 patients is reviewed. Particular attention is given to the 23 patients who died after operation. There were 15 deaths in the 38 patients who were classified as cyanotic and 8 deaths in the 28 acyanotic patients. The use of general body hypothermia to between 20 and 24 degrees C. plus additional selective cooling of the heart with cold Ringer's lactate solution during aortic occlusion has significantly reduced the mortality in the last 20 cases. In both the cyanotic and acyanotic groups the most common cause of death was a right ventricular outflow tract which was too small. When the pulmonary valve was rendered incompetent it was found that a higher than normal venous and right atrial pressure was necessary for adequate filling of the right ventricle. Two deaths were thought to have resulted from venous pressures being maintained too low in the postoperative period. One death resulted from a right-to-left shunt through an unrecognized patent foramen ovale in the presence of an elevated right atrial pressure due to pulmonary valve insufficiency. Other causes of death which were noted in this study were bleeding, digitalis intoxication, infection, and heart failure.

The surgical technique of repair is presented in detail and involves a median sternotomy with early obliteration of previously performed systemic-to-pulmonary artery shunts. The shunt from a Potts' procedure is controlled temporarily through an opening in the pulmonary artery while cooling progresses and is repaired through the pulmonary artery when 20 degrees C. has been reached. The closure of the ventricular septal defect is by direct suture with an overlay patch of crimped dacron. Only 4 patients in the series had heart block using this technique. Wide resection of the infundibulum is carried out to provide the widest possible outflow tract. A gusset of crimped dacron may be used and extended beyond the valve ring when necessary. Unless the right ventricular pressure can be reduced to at least half that of the left ventricular pressure chances of survival are not good. It is the practice of the authors now to utilize bypass for further enlargement of the outflow tract when unfavorably high pressures remain in the right ventricle. —*George R. Holswade.*

ESOPHAGUS AND MEDIASTINUM

Tumors of the Thymus. DAVID P. BOYD, HERBERT D. ADAMS, and FRANKLYN P. GERARD. *Surg. Clin. N. America*, 1961, 41: 667.

FOUR PATIENTS had thymomas coexisting with myasthenia gravis with only 1 survival. There were 13 other patients with thymomas with 3 survivals of more than 5 years, for an over-all total of 17 patients with 4 survivals, or 23.5 per cent, after 5 years.

With this extremely serious prognosis in thymic tumors, whether histologically malignant or benign, treatment should be aggressive. Most of these tumors, because they have initially appeared in one thorax or the other, have been removed from the mediastinum by a transthoracic approach. A number of them have recurred and re-exploration by a transsternal approach showed widespread disease and involvement of the pleura and pericardium with involved nodes in the neck. It is suggested, therefore, that all such tumors be approached through the sternum, removing the tumor as widely as possible and including the entire thymus, all of the surrounding areolar tissue, and the nodes up into the base of the neck.

Two million volt roentgenotherapy should be given to these patients in the postoperative period. When thymomas coexist with myasthenia gravis, since the operative mortality rate is high, it may be wise to give two million volt roentgenotherapy prior to operation in an effort to control the two diseases as thoroughly as possible before a major operation is carried out. —*Harold Laufman.*

Hiatal Hernia as a Complication of the Heller Operation. ALFRED S. FROBESE, GEORGE N. STEIN, and HERBERT R. HAWTHORNE. *Surgery*, 1961, 49: 599.

BECAUSE THE phrenoesophageal ligament is relaxed or atrophic in hiatal hernia and taut in achalasia, the two would be thought to coexist rarely. In fact, only several cases of patients with both achalasia and hiatal hernia have been reported. However, as a result of operative alteration of the esophageal hiatus with division of the phrenoesophageal ligament, there is a significant incidence of hiatal hernia after the modified Heller operation for achalasia, especially if the abdominal approach is used. This fact was demonstrated when hiatal hernia developed in 4 patients out of a group of 48 who had undergone esophagomyotomy in the Graduate Hospital of the University of Pennsylvania, Philadelphia. All 4 complained of epigastric and substernal distress or dysphagia, and 3 were found to have esophagitis and ulceration. One patient had transthoracic repair of the hiatal hernia, and another had resection of the distal esophagus with vagotomy and jejunal interposition. Both patients were relieved of their symptoms. One patient refused surgical repair, and the other is being treated medically.

Several surgeons have described reconstruction of the hiatus as a required step in esophagomyotomy to prevent reflux of gastric contents. If the hiatus is restored to a normal diameter by suturing the edges of the right crux posteriorly, and the severed phrenoesophageal ligament is repaired, whether the approach were transthoracic or transabdominal would seem of little importance. —*James J. Mongé.*

The Treatment of Regurgitant Esophagitis by Reconstruction of the Cardiac Sphincter Mechanism in Patients with No Demonstrable Hiatal Hernia. FREDERICK S. CROSS, EARLE B. KAY, and GEORGE V. SMITH, JR., *Dis. Chest*, 1961, 39: 530.

THE REFLUX of gastric juice into the lower esophagus is a sine qua non in the development of esophagitis.

The commonest cause for this reflux is an incompetent cardiac sphincter mechanism associated with a hiatus hernia. Hiatus hernia can be demonstrated roentgenographically in from 60 to 85 per cent of individuals with proved esophagitis, depending on the magnitude of the hernia and the efforts made by the roentgenologist to achieve an adequate demonstration. Because of the difficulty in demonstrating some of the smaller hiatus hernias, it may be assumed that a hernia is present when esophagitis has been demonstrated endoscopically, even though the hernia cannot be demonstrated roentgenographically.

In 8 patients with proved chronic acid-peptic esophagitis, in whom no hiatal hernia could be demonstrated by roentgen studies, this assumption was made. All 8 patients underwent thoracotomy and hiatal hernia repair after the method described by Allison. The 8 patients ranged from 35 to 49 years of age, and at operation anatomic changes related to the esophageal hiatus were observed in all patients. In 5, a small herniation of the stomach into the chest was seen, although this had not been demonstrated roentgenographically, and in 3 the hiatus was more patulous than normal.

Symptoms in all 8 patients were greatly alleviated by operation which consisted essentially in reducing the hiatus hernia, reconstructing the esophageal hiatus by approximating the two limbs of the right diaphragmatic crux, and fixation of the gastric fundus to the undersurface of the diaphragm.

All of these patients had undergone prolonged periods of accepted medical therapy for this condition without relief of symptoms. It is suggested that this operation is the procedure of choice in patients with reflux esophagitis who have not responded to medical treatment and in whom a hiatus hernia cannot be demonstrated roentgenographically.

—*Frank J. Milloy.*

SURGERY OF THE ABDOMEN

ABDOMINAL WALL, PERITONEUM, AND HERNIA

Blunt Abdominal Trauma. CHADWICK F. BAXTER and ROGER D. WILLIAMS. *J. Trauma*, 1961, 1: 241.

BLUNT TRAUMA TO THE ABDOMEN is of more frequent occurrence in civilian life than penetrating injuries to the abdomen. The findings in 158 patients who sustained such blunt trauma have been compared with similar experimental trauma in the dog.

The injury in the dog was produced by dropping a solid weight against the abdomen in pendulum fashion. All animals were examined after the trauma, needle paracenteses of the abdominal cavity were performed, the animals were then sacrificed, and the abdominal cavity was explored to determine the injury.

Splenic injury occurred more frequently in the dog than in humans. Over one-half of the splenic injuries were subcapsular hematomas. Many of these would be missed in the patient unless the abdomen was explored. Injuries to the liver were also more common in the dog, probably for the same reason. Renal and pancreatic injuries were more frequent in the human than in the experimental animal. The incidence of flank trauma in the human is not known. Roentgenographic study showing distortion about the kidney would disclose an increased incidence, the experimental injuries being determined by exploration only. The pancreas is not fixed in the dog, and this may protect the organ. Hollow visceral and mesenteric injury was more common in the animal than in man. Frequency of abdominal exploration would have an effect on its incidence.

Increasing the size of the striking object and the energy of the blow in the experimental animal resulted in an increase in the number of viscera injured. This was true of all organs except the liver and mesentery. Pneumoperitoneum did not change the frequency of solid visceral injury, but served as a buffer with regard to bladder and intestine, both organs being less frequently injured. Paracentesis of the abdomen produced bloody taps in 90 per cent of the experimental injuries.

The results of these studies suggest the need for further evaluation of the causative factors in abdominal trauma. The effect of intestinal distention with air or fluid especially requires further investigation. —*Donald C. Geist.*

Retroperitoneal Tumors in Infants and Children. NEWLIN HASTINGS, WILLIAM F. POLLOCK, and WILLIAM SNYDER, JR. *Arch. Surg.*, 1961, 82: 950.

RETROPERITONEAL TUMORS make up a major portion of the malignant neoplasms of the very young. Although diverse pathologically, retroperitoneal tumors have certain clinical characteristics in common. The most common initial sign is a mass. The commonest retroperitoneal tumor, if one excludes lymphatic, mesenteric, and pancreatic enlargements, is the Wilms tumor followed closely by neuroblastoma and undifferentiated sarcoma. Miscellaneous benign neoplasms account for about 4 per cent of the retroperitoneal tumors and include teratoma, lipoma, ganglioneuroma, and paraganglioma.

The majority of neoplastic lesions in the retroperitoneal space displace adjacent viscera. Pain is vague and unreliable but was noted in about one-third of the cases reported. Fever is a common finding in these patients and is usually the result of necrosis of the tumor tissue rather than that of infection. Roentgenographic examinations are important to demonstrate the presence of a mass, to assess the nature and extent of the primary lesion, and to determine the presence of metastases. Excretory pyelography must be a routine part of the evaluation of all retroperitoneal tumors. Chest examinations and skeletal surveys are necessary to determine the presence or the extent of metastatic spread. Distant metastases were present at the initial examination in 58 per cent of the patients reported. Highly valuable information can be obtained from needle biopsy of the bone marrow and skeletal lesions. The authors are opposed to percutaneous needle biopsy of the primary retroperitoneal tumor if any possibility of open exploration exists. Retroperitoneal tumors should be routinely approached transperitoneally. This approach makes possible a definite histologic diagnosis and the assessment of the nature and the extent of metastases.

A complete discussion of Wilms's tumor and neurogenic tumors is included in this report. Conclusions made are: (1) Every retroperitoneal tumor must be considered malignant until proved otherwise; (2) prompt excision should be the primary objective using a transperitoneal excision even if metastases are present; and (3) roentgenotherapy should be given postoperatively. There is hope for survival even with metastatic lesions, and chemotherapy offers additional promise for the future. The ominous signs of a bad prognosis are: age greater than 3 years at diagnosis, persistent hematuria, persistent hypertension, severe anemia at the time of diagnosis, established distant metastases, and bilateral renal involvement.

—*Lloyd D. MacLean.*

Inguinal Hernia: Infancy and Childhood. THOMAS V. SANTULLI and ANTHONY SHAW. *J. Am. M. Ass.*, 1961, 176: 110.

THE AUTHORS examined 359 pediatric patients who had had a unilateral inguinal hernia repair at least 5 years previously. They found a 12 per cent incidence of subsequent contralateral hernias. Four-fifths of the patients who had second hernias had their lesions detected within a 3 year period after the first hernia repair.

In another group of 175 patients with unilateral hernia, the opposite inguinal canal was explored with positive results in 56 per cent. The authors attribute the discrepancy between these two groups in part to

the difficulty of distinguishing a true hernial sac from a patent processus vaginalis. The clinical importance of a patent processus vaginalis is questioned.

The current policy of the authors is the immediate surgical repair of inguinal hernias as soon as the diagnosis is made. The opposite side is examined clinically. It should be explored if there is a reliable history of hernia and if there is a hydrocele or definite thickening in the spermatic cord suggesting a hernial sac. The so-called blind or routine exploration is not recommended. —*Jerome J. DeCosse.*

GASTROINTESTINAL TRACT

Civilian Penetrating Wounds of the Abdomen. HARWELL WILSON and ROGER SHERMAN. *Ann. Surg.*, 1961, 153: 639.

FOUR HUNDRED AND NINETY-FOUR PATIENTS with penetrating abdominal wounds admitted from 1948 through 1959 inclusive were analyzed for differences from war wounds and for factors contributing to mortality. Four hundred and thirty patients with wounds limited to the abdomen remained for analysis after thoracoabdominal wounds, deaths prior to treatment, and wounds not involving the peritoneal cavity were excluded.

Fifty-eight per cent of patients had stab wounds and 42 per cent had gunshot wounds. Nearly all wounds, 94.8 per cent in this series, were produced by weapons rarely used in military combat.

Mortality was 0.8 per cent in patients with negative laparotomy and 3.7 per cent in patients thought not to have perforating wounds and treated without laparotomy. Diagnostic roentgenographic examination of the abdomen was inconclusive in over 85 per cent of 327 cases. Mortality was 5.8 per cent, 25 patients, in 430 treated.

Age, cause, time lag, blood loss, multiple organ injury, specific organ injury, and complications were evaluated as factors in mortality and compared with military cases. Influence of specific treatment on mortality and morbidity of individual organ injury was not included in this report. Factors contributing to mortality as well as other factors evaluated in our cases were not comparable to those reported in military series.

Further lowering of mortality and morbidity in civilians will depend on further study of civilian cases with revision of military standards of treatment not applicable to civilian wounds. —*John J. Maloney.*

Multiple Lymphomatous Polyposis of the Gastrointestinal Tract. JOHN S. CORNES. *Cancer*, 1961, 14: 249.

THE SUBJECT OF multiple polypoid lymphomatous lesions of the bowel is reviewed and 5 additional cases are reported in detail. Two of these 5 patients came to postmortem examination and quite a complete study was made. It is stated that all types of lymphoma can occur in this pattern and that the prognosis is similar to that in the varieties that occur elsewhere.

Malignant lymphomas may appear as multiple polyposis affecting long segments of the gut. As expected, these patients usually have complaints referable to the bowel and evidence of systemic involvement is usually late. None of the known cases has been complicated by the appearance of leukemia. The lesions occur in the mucosa and submucosa and usually involve long segments or all of the gastrointestinal tract. Deep roentgen therapy seems to produce symptomatic relief; but it is difficult to assess improvement in terms of survival time resulting from any therapy. —*Robert W. Williams.*

Carcinoid Tumors of the Stomach. OLE EKLÖF. *Acta chir. scand.*, 1961, 121: 118.

THE AUTHOR BEGINS this comprehensive article with a review of the current literature on carcinoid tumors and their endocrine functions. He quotes Pearson and Fitzgerald, who stated the incidence of carcinoids of the stomach to be 2 to 3 per cent of all carcinoid tumors. Because of the rarity of this tumor, there have been only 63 cases reported in the world literature. To this number the author adds 3 additional cases which have been diagnosed and studied at Karolinska Sjukuset, Stockholm, Sweden.

In all 3 cases the presenting complaint at the time of admission was that of melena and associated anemia. Two of the patients, however, complained of vague abdominal distress for several years prior to seeking medical attention. None of the patients had any of the symptoms characteristic of the carcinoid syndrome.

Roentgenographic examination of all patients revealed a space-filling defect within the stomach, which was clearly demarcated from the surrounding tissues, and which contained a central depression characteristic of ulceration.

All patients were operated upon, and in all instances the tumor was easily resectable. Two of the patients required only local resection of the tumor mass, whereas the third, because of dense adhesions between the stomach and pancreas, required a subtotal gastric resection.

Histologic examination revealed infiltrative growth in 2 of the cases. In all 3 cases monomorphic cells with large nuclei and a moderate amount of cytoplasm were found. In 1 case mitoses were plentiful, and only in this case was the argentaffin reaction noted.

Two of the patients are alive and well, 5 and 7 years after operation. The third succumbed after 5 years to a primary cerebral neoplasm, and autopsy failed to reveal any evidence of recurrence of the carcinoid tumor.

Of all the reported cases of carcinoid of the stomach, in only 2 instances was the diagnosis made preoperatively, and in both these cases a manifest carcinoid syndrome was present. The typical roentgenographic findings are characteristic only of a tumor of nonepithelial origin. The special staining techniques commonly used for carcinoids unfortunately are inapplicable to frozen section material. Because of the favorable prognosis of carcinoid tumors, a preoperative diagnosis might well affect the extent of the resection.

In view of the aforementioned facts, Thorson suggests that 5-hydroxyindoleacetic acid determinations be made on the urine of all patients with silent gastrointestinal tumors. To this the author recommends that in all cases in which the diagnosis is still in doubt

a determination of 5-hydroxytryptamine in the portal blood should be obtained. The author describes his technique for percutaneous liver puncture, in which a needle within a thin polyethylene catheter is introduced into the liver. The needle is withdrawn, leaving the catheter in place, and then the catheter is slowly withdrawn until a free flow of blood is obtained. Under television fluoroscopy a few cubic centimeters of contrast medium are injected into the catheter, which readily distinguishes the portal from the hepatic venous system. The portal blood thus obtained may then be used for 5-hydroxytryptamine determination prior to operation. The author suggests that this additional laboratory aid may well increase substantially the number of preoperative diagnoses made on carcinoid tumors of the gastrointestinal tract. —*Stuart M. Poticha.*

Experiences with a Billroth I Reconstruction Following Vagotomy and Antrectomy for Duodenal Ulcer. J. Lynwood Herrington, Jr., Kenneth L. Classen, and Leonard W. Edwards. *Ann. Surg.*, 1961, 153:575.

A total of 306 patients who underwent vagotomy and antrectomy with end-to-end gastroduodenostomy have been followed up. The combination of complete vagotomy and 40 to 50 per cent distal gastrectomy (antrectomy) with gastroduodenostomy appears to exert considerable protection against recurrent ulceration.

Satisfactory postoperative results were obtained in 93 per cent of the group.

Two cases of recurrent ulceration, an incidence of 0.65 per cent, have occurred. No incidence of a suspected recurrence has been noted.

—*Ernest D. Bloomenthal.*

Some Psychiatric Consequences of Gastrectomy. F. A. Whitlock. *Brit. M. J.*, 1961, 1:1560.

The author reports on 25 patients, 17 men and 8 women, who were admitted to psychiatric wards and had previously undergone gastric surgery. Three of the women were drug addicts, and the remainder had mixed anxiety depression symptoms. Of the 17 men, 9 were admitted directly or indirectly for alcoholism, 2 for drug addiction, and 6 for mixed neurotic and depressive states. Almost all of the patients complained bitterly of dumping symptoms.

It was difficult to obtain a clear picture of the premorbid personalities of these patients. Judging by the work record, by the absence of overt psychiatric illness, and by the general level of social adaptation, 3 of the male alcoholics had been normal up to the time of operation, but 5 had shown psychopathic features. Of the 9 alcoholics, 5 had been moderate and 4 heavy drinkers before the operation.

Although no statistical picture emerges from the small number of cases, the outstanding feature is a high incidence—56 per cent—of alcoholism and drug addiction. All the alcoholics and drug addicts in this series had undergone their partial gastrectomies for relief of duodenal ulcer symptoms. A great many of them attributed their addiction to the necessity for relief from dumping symptoms.

The author suggests that patients with duodenal ulcers, who are known to be moderate drinkers, may be poor risks for gastric surgery. Undue preoccupation with dumping symptoms, persistent loss of or failure to regain weight, and repeated requests for habit-forming drugs should be regarded as warning signals that the patient might be headed for addiction. Patients who show psychopathic features, or who are prone to resort to alcohol to relieve anxiety, should be detected before operation in order to avoid some of the unfortunate consequences attributed to gastrectomy. —*Carl H. Calman.*

Duodenal Fistulas. R. J. Brouwer. *Arch. chir. Neerl.*, 1960, 12:467.

The reported mortality for postoperative duodenal fistula has varied from 16.6 to 85 per cent, but the author believes that the prognosis with present day therapy may be quite favorable. The end-type of duodenal fistula is situated intraperitoneally and the typical example occurs after Billroth II gastric resections. The lateral type most often occurs extraperitoneally as a result of biliary tract surgery, right hemicolectomy, difficult right-sided nephrectomy, or blunt abdominal trauma, and is due to duodenal laceration, impairment of circulation by ligatures, contusion, or inflammation.

Early diagnosis can be confirmed by determining the *p*H and amylase content of the wound discharge, and the oral administration of methylene blue. The loss of active digestive juices soon leads to dehydration, electrolyte deficiencies and imbalance, uremia, and hypoproteinemia. A detailed description is given of a patient in whom such a fistula developed 8 days after right nephrectomy for pyelonephritis with abscess-forming perinephritis. Recovery followed conservative therapy. Continuous wound suction was obtained by a catheter placed inside a hard rubber drain in the depths of the wound to permit the ingress of air and prevent blocking. A nasoduodenal tube with constant suction was also used, and the patient was positioned on the left side. The skin was protected by zinc oxide paste. Serum electrolytes, as well as losses of electrolytes in the urine and wound drainage and duodenal aspirate, were checked regularly and adequate replacement made. After a Witzel jejunostomy was established replacement was simplified and feedings were begun, thus reducing the need for frequent blood and plasma transfusions.

Reoperation in the invariably infected field with the attempt to repair the friable, partly digested tissue is usually unsuccessful. Gastroenterostomy with pyloric occlusion or gastric resection has a high mortality. Attention should instead be directed to adequate drainage and skin protection, restoration and maintenance of fluid and electrolyte balance, and the supplying of nutrients. —*James J. Mongé.*

Duodenal Obstruction of Congenital Origin. Clifford D. Benson and James R. Lloyd. *Am. J. Surg.*, 1961, 101: 610.

The most common cause of intrinsic duodenal obstruction in the newborn is duodenal atresia. Vomiting is a more consistent symptom than upper abdominal distention. In 95 per cent of cases, obstruction is below the ampulla of Vater. Hence, vomitus contains bile, and stools, if present, are scanty, grey-green, and

mucoid. The majority of these infants are the result of pregnancies complicated by hydramnios. The classic roentgenologic sign in duodenal atresia is the "double bubble" seen in the upright film and caused by gas in the stomach and duodenum and no gas present elsewhere.

After correction of any fluid and electrolyte imbalance, the lesion is surgically bypassed, preferably by a retrocolic duodenojejunostomy for lesions distal to the ampulla or by gastroenterostomy for proximal lesions. Before anastomosis, the distal collapsed bowel is distended with air and saline through a No. 22 gauge needle, to detect additional defects and to facilitate the anastomosis.

Postoperatively, continuous gastric suction is essential. The use of gastrostomy instead of conventional nasogastric suction has the advantages of permitting a larger and more efficient tube and avoiding pharyngeal or esophageal complications. Infants are weighed at 8 hour intervals. Maintenance of a constant weight or a daily loss of up to 40 gm. is considered satisfactory. Any persistent weight gain is a warning of possible overhydration. Small oral feedings are usually resumed on the third postoperative day.

Duodenal stenosis occurs in varying degrees. If obstruction is nearly complete, bilious vomiting occurs promptly and roentgenographic findings resemble atresia except that some gas may be seen in the distal part of the bowel. Usually, vomiting is delayed for days or weeks and is then intermittent. This picture, along with growth failure, is identical to that produced by malrotation of the intestine, and a barium enema should be given to identify the latter condition. Surgical treatment for stenosis is similar to that for atresia, though occasionally a direct attack on the stenotic area is feasible.

Annular pancreas presents similar symptoms of partial duodenal obstruction, and surgical correction involves a bypassing procedure, preferably retrocolic duodenojejunostomy. Congenital bands across the duodenum present a similar picture and surgical release of the bands is indicated.

Malrotation may produce intermittent symptoms for years, for duodenal obstruction is incomplete. Blood in the stool is a warning that strangulation of the twisted mesentery may be occurring, and prompt surgical intervention is necessary. A barium enema is diagnostic. The corrective operation consists of severing the obstructive bands that cross the duodenum, swinging the freed cecum to the left, dividing the bands between the distal duodenum and colon, and placing the duodenum in a new course straight down the right lateral gutter.

The incidence of associated congenital abnormalities must be considered. The incidence of mongolism in the authors' series of 43 cases was 10 per cent.

—*Stanley W. Tuell.*

Duodenal Stenosis. W. A. Bax. *Arch. chir. Neerl.*, 1960, 12: 448.

Congenital obstruction of the duodenum can be due to complete atresia of the bowel lumen, to partial stenosis resulting from an intraluminal septum, external pressure on the duodenum from an annular pancreas, tumors, or cysts of adjacent organs, or to insufficient rotation of the intestine with connective tissue adhesions to the posterior abdominal wall. Also to be considered are adhesions and strands of connective tissue that cause kinking of the duodenojejunal junction. In the case of duodenal stenosis with partial obstruction vomiting may not occur until the infant is several weeks old. In a few patients symptoms are not manifest until later in life.

If the emesis contains much bile the obstruction is distal to the papilla of Vater. Roentgenographic examination by means of a scout film and, if necessary, with lipiodol is a valuable diagnostic aid. Pyloric stenosis must be differentiated, but differentiation is usually possible by means of the infant's age, i.e., 4 to 6 weeks, a palpable pyloric tumor, and the roentgenograms.

After the few hours necessary for correction of fluid and electrolyte balance and aspiration of the stomach, operation must be carried out. When there is intrinsic obstruction of the duodenum or an annular pancreas, gastrojejunostomy or duodenojejunostomy is required. A duodenojejunostomy is generally tolerated better than a gastrojejunostomy. When the stenosis is caused by occluding strands of connective tissue, the obstruction can be relieved by just severing the adhesions and no anastomosis need be made. The surgeon must be certain that no further obstruction of the lumen by a septum exists by observing the intestinal contents to pass on into the jejunum before he omits an anastomosis. Case reports of 4 infants and one 7 year old boy who had duodenal obstruction as a result of connective tissue strands near the duodenojejunal flexure are given and discussed. —*James J. Mongé.*

The Use of the Jejunum in Upper Abdominal Surgery and a Comparison with Esophagogastrostomy. Douglas Robb. *Austral. N. Zealand J. Surg.*, 1961, 30: 252.

The author discusses his experience in using segments of jejunum in 17 cases consisting of esophageal stricture caused by hiatus hernia, esophageal stricture after operations for achalasia, after radical resection for carcinoma of the stomach, after total gastrectomy for nonmalignant conditions, and for bleeding varices in portal hypertension. In his article he describes the purposes of the jejunal segment as follows: (1) To bridge a gap after esophageal or gastric resection; (2) to form a reservoir after partial or total gastrectomy; (3) to act as an antireflux device; (4) to act as a vein block in portal hypertension; and (5) to receive bile and pancreatic secretions after damage to the common bile duct and resection of the duodenum. The jejunum is used as a Roux loop, an inverted U loop, or as an isolated segment.

The author then comments on several technical points contributing to the complications and difficulties which he has encountered, including attention to the anastomosis, the blood supply, relation to the hiatus, general disposition of the loop, and the need for pyloric relaxation in all cases in which the resection has sacrificed the vagus nerves. In employing the segments of jejunum for upper abdominal surgery he has noted the following complications: Fatal kinking, postoperative hiatus hernia, strangulation, stricture of the esophagojejunal anastomosis, shock and peri-

tonitis, and empyema. Despite these many possible complications, however, there are many favorable results from employing the use of the jejunal segment. Of 17 cases in which it was used the results were satisfactory in 14.

The author then comments on the use of esophagogastrostomy after resection of varying portions of the stomach and esophagus and mentions this as the chief alternative to the use of the jejunum in many of these situations. He mentions his results in 24 cases for conditions such as hiatus hernia with stricture, caustic stricture, esophagitis, stricture from foreign body, bleeding varices, and after resection for cardiospasm. Among these 24 patients there were 5 deaths.

He concludes that the use of the jejunal segment is somewhat more tedious and delicate in execution and more prone to postoperative complications and sequelae. It should, therefore, be reserved for circumstances with a particular indication such as the need for capacity and the need to guard against reflux, as in varices. It is not particularly suited for very high anastomoses in which esophagogastrostomy is a good operation. —*Donald M. Clough.*

Tumors of the Small Bowel. J. M. KROUSE, R. C. EYERLY, and J. R. BABCOCK. *Am. J. Surg.*, 1961, 100: 121.

DURING A 33 year period, 36 primary tumors of the small bowel were discovered in more than 200,000 admissions. Eighteen of these tumors were asymptomatic; 16 of these were benign. Of the 18 symptomatic tumors, 10 were malignant. The age and sex incidence in the symptomatic and asymptomatic groups were identical. The symptoms were bleeding, obstruction, or abdominal pain, with relatively little difference between the malignant and the nonmalignant groups. Intussusception was found more frequently in the benign series than in the malignant group. The diagnosis can be made by a flat roentgenogram of the abdomen or with a gastrointestinal series. Discovery alone is an indication for operation. The prognosis is poor, with only 2 of the 12 patients with malignant lesions alive less than 3 years after operation. Leiomyosarcoma of the small bowel has a longer survival than adenocarcinoma.

—*Harold M. Unger.*

Regional Enteritis. GORDON MCHARDY. *Texas J. M.*, 1961, 57: 365.

THE AUTHOR REVIEWED the literature and 88 patients with regional enteritis seen at the Browne-McHardy Clinic at the Louisiana State University School of Medicine and Touro Infirmary, New Orleans, Louisiana.

Thirty-four of the 88 patients were Jewish. The disease has been discovered in all races and is more common in youth, the average age being 26 years. The cause remains obscure. The author noted trauma to precede this disease in 23 of his patients, in 5 after automobile accidents, and in 18 after the traumatic effects of selfrectifying intussusception or volvulus. Pathologically, the process is said to originate in lymphoid hyperplasia or granulomatous lymphangitis obstructing lymphatic vessels of the intestinal wall with resulting submucosal lymphedema, mucosal ulceration, secondary bacterial involvement with intramural abscesses, fistula formation, and stenosis. The diseased segment may be sharply demarcated but often is graduated into areas of acute hyperemia, vascular engorgement, and plastic exudate. The mesentery is thick and edematous, with enlarged lymph nodes exhibiting giant cell systems devoid of acid fast organisms.

No definite clinical picture characterizes regional enteritis, necessitating diagnosis by exclusion or exploratory laparotomy. Of 88 patients, 42 had acute symptoms, whereas a history of chronic disease beyond 4 years' duration was present in the remaining 46. Exploratory laparotomy was performed on 38 patients with the preoperative diagnosis of appendicitis in 33, Meckel's diverticulum in 2, ectopic pregnancy in 2, and small bowel obstruction in 1. An impression of psychosomatic disease had been given by the physician in 49 of 88 patients. Roentgenographic signs are quite variable, depending on the course of the disease. The Kantor "string sign" resulting from stenotic lesions, delayed motility with obstructive ileal lesion, and "skip area" have been demonstrated.

Of 68 patients 37 were gainfully employed, 16 were self-sustaining but under medical care, 9 were dependent and debilitated, and 6 had died, 3 as a result of operation. Thirty-four patients required further operation, more often after the short circuiting procedure.

The following operative procedures have been used: 1 stage extensive resection with enterocecostomy; 2 stage resection with initial short circuiting procedure with or without ileal transection and later resection; simple enterocolostomy with or without ileal transection; and transthoracic bilateral vagotomy to control diarrhea. Ileostomy, or colostomy, or both may be necessary in the "blind loop syndrome."

Treatment of this condition is essentially medical to control motility, nutrition, anemia, electrolyte imbalance, toxemia, and infection. Operation is reserved for intractability, progression, or complications. Relief, not cure, is anticipated. Recurrences are the same regardless of the surgical procedure used and these are considered to be the result of the progression of the disease and not of the type of operation used. Appendectomy when feasible, avoidance of side-to-side anastomosis, and ileal transection in a short circuit procedure is advised. —*John J. Hudock.*

An Improved Technique of Colectomy for Ulcerative Colitis and Disseminated Adenomatosis. HARRY E. BACON and TEODORO P. NUGUID. *Dis. Colon & Rectum*, 1961, 4: 159.

THE AUTHORS have described in some detail an improved technique which has been utilized in the performance of a one-stage ileocoloproctectomy, with establishment of an ileostomy, in 65 patients with ulcerative colitis and 21 patients with disseminated adenomatosis of the colon. The mortality rate for these two groups was 1.1 per cent.

The site for establishment of the ileostomy is marked precisely with sterile methylene blue. A left hockey-stick incision angled to the left costal arch is utilized to enter the abdomen. The blood supply of the entire

colon is kept intact until the end of the resection in order that it may be terminated at any point if the situation should require. The rectum is freed up posteriorly and anteriorly as for an abdominoperineal resection, although in this instance the dissection is carried closer to the bowel in order to avoid injury to the presacral nerves. The small bowel is divided approximately 20 to 25 cm. proximal to the ileocecal valve. A small portion of the proximal ileum which is to serve as the permanent stoma is removed for frozen section in order to be certain that it is free of disease. The rectosigmoid colon is divided between clamps; the distal end is covered with a rubber dam and tied with a heavy silk ligature. A 4 inch length of ileum is withdrawn through the opening previously constructed in the right lower quadrant.

The perineal phase of the operation is very much the same as is commonly used for the ordinary abdominoperineal resection. The authors prefer to pack the wound open with a rubber dam and gauze.

The postoperative management of these patients is relatively standard for operations of this type. The authors employ antibiotic agents regularly. The sump drain in the abdominal wound is removed in 36 to 48 hours. Early ambulation is practiced and early instruction in the care of the ileostomy is considered important. —*Harvey N. Lippman.*

Appendicitis and Ligneous Perityphlitis. James C. Rex, Edgar G. Harrison, Jr., and J. T. Priestley. *Arch. Surg.*, 1961, 82: 735.

The report concerns an unusual lesion, ligneous perityphlitis, derived from a nonspecific, tumefactive, inflammatory, fibroblastic process beginning in the appendix and involving the periappendiceal tissues and cecum. Clinically, it often has been confused with carcinoma. At operation, even though the process is thought to be inflammatory, it is considered important to remove all diseased tissue to prevent such complications as sinus tract and fistula formation. Right hemicolectomy was necessary in 10 of the 14 patients on whose records this article was based.

Histopathologic study of these cases revealed early and late characteristics of the lesion. In the group with smaller, less firm lesions microscopy revealed considerable evidence of inflammation and little of fibrosis. Lesions from patients in the other group were large and hard or woody in consistency. Microscopy revealed minimal inflammation and marked fibrotic and sclerosing reactions similar to other processes, including sclerosing retroperitonitis and mediastinitis. These sclerosing lesions of the appendiceal area are thought to represent an unusual type of healing of appendicitis, representing a balance between host resistance and bacterial virulence which results in hypertrophic scarring and a truly chronic type of appendicitis.

Management of Polyps of the Rectum and Colon. Wadie J. Hamandi and Guy L. Kratzer. *Dis. Colon & Rectum*, 1961, 4: 173.

The authors have presented their personal experience with 9,600 consecutive proctosigmoidoscopic examinations in relation to the incidence and management of polyps of the rectum and colon. Six hundred and sixty-one of these patients had at least one polyp at the time of the first examination.

Seventy-five per cent of all diseases of the colon and rectum can be diagnosed by changes which are observable through the sigmoidoscope. A strong plea is made for early sigmoidoscopic examination in any patient who complains of an alteration of bowel habit, particularly when there is associated bleeding. It is suggested that every polyp which is successfully treated represents a cancer which has been prevented.

Colonic polyps are either pedunculated or sessile. Soft polyps are usually benign. Pedunculated polyps may often be removed through the anus with the aid of a snare. Evidence of malignancy within the polyp is of less significance than invasion of its stalk. The latter militates strongly for more radical surgery. Soft sessile polyps, not involved by carcinoma, may be fulgurated successfully from below. Fulguration is often performed in several separate procedures. If the polyp is situated above the peritoneal reflection, the additional danger of perforation must be recognized. The authors state that polypoid lesions larger than 5 cm. in diameter are apt to be malignant.

Of the large number of patients examined by the authors, only 48 out of 661 patients with one or more polyps required laparotomy. Colotomy and colonoscopy were performed in the majority of cases and simple excision or fulguration used as the method of removing the polyp. In a few instances large sessile polyps for which laparotomy was required also required resection and anastomosis.

—*Harvey N. Lippman.*

Congenital Abnormalities of the Anus and Rectum. Malcolm H. Gough. *Arch. Dis. Childh.*, Lond., 1961, 36: 146.

The most important factor with regard to treatment and prognosis in cases of congenital abnormality of the anus and rectum is whether the bowel terminates above or below the pelvic floor. A primary distinction therefore is made between high and low abnormalities. In the low abnormalities the bowel passes through a normal puborectalis sling and pelvic floor, and continence is assured even in the presence of an abnormal external sphincter. Treatment is therefore easier and less prolonged than in the high cases in which an abnormal pelvic floor and deficient internal and external sphincter mechanisms usually exist.

The low abnormalities are subdivided into: the covered anus, the ectopic anus, the stenosed anus, and the anorectal membrane.

There were 323 patients treated, 192 having low anomalies and 131 having high anomalies; 57 per cent of the children were males.

Results of treatment show 86 per cent good results in the low cases compared with 30 per cent in the high. Twenty-five per cent of the low cases have associated anomalies, compared with 62 per cent of the high, and the latter are usually of a more severe nature. The mortality rate for the low cases is 5.7 per cent and for the high cases 35.9 per cent. The latter figure, if corrected for anorectal agenesis seen and treated neonatally, rises to 46 per cent.

This is the largest series of these cases yet recorded. Well-documented series have been reported from

the United States, but unfortunately comparison of results is impossible because of differences of classification. Consequently, standardization of nomenclature is most urgently needed.

—*Stephen A. Zieman.*

LIVER, BILIARY SYSTEM, AND PANCREAS

Intrahepatic Calculi. FRANK GLENN and FRANK G. MOODY. *Ann. Surg.*, 1961, 153: 711.

CALCULI within the intrahepatic ductal system may cause symptoms that closely mimic those produced by calculi elsewhere in the biliary tract. If calculi are retained in a cisternal dilatation of an intrahepatic duct they may be the source of "recurrent" common duct stones.

The incidence of intrahepatic calculi is quite low in the United States when one considers the large number of patients treated surgically for calculous disease of the biliary tract. It is seen more frequently throughout the Far East, specifically in China and Japan. That there have been so few reports from America and Europe probably indicates that it is not only rare but also that it escapes recognition by both clinician and pathologist. Each must exercise extra effort to establish the diagnosis. The surgeon informed of this condition and suspecting it because of either a history of repeated operations for removal of common duct calculi or findings at operation may establish the diagnosis by cholangiography. The pathologist at postmortem examination, of course, has the optimum opportunity to see in detail the enlarged ducts containing calculi and associated changes.

—*John J. Maloney.*

Portal Hypertension, Its Diagnosis and Treatment. J. ZAAIJER. *Arch. chir. Neerl.*, 1960, 12:431.

THIS WORTHWHILE ARTICLE is a report on the surgical treatment of 27 patients with intrahepatic and 11 with extrahepatic portal hypertension to prevent further hemorrhage from esophageal varices. The pathogenesis of portal hypertension in cirrhosis is reviewed, with emphasis on the destruction of the hepatic sinusoids which makes the nutrition of the cirrhotic liver largely dependent on the arterial blood supply and the nodular regeneration of liver cells which distorts the central veins. The diagnosis of gastrointestinal bleeding due to portal hypertension in cases of cirrhosis is important since laparotomy and portacaval anastomosis are not advisable when liver function is further impaired by hemorrhage and shock.

Splenoportography is an aid to the surgeon in evaluating the site of obstruction, the condition of the portal vein, the degree of sinusoidal filling of the liver, and the diameter of the splenic vein. In intrahepatic portal hypertension the portal vein may be obstructed by a thrombus, necessitating a splenorenal shunt. The method of splenoportography used is described. In order to reduce the risk, the examination is best made just before operation.

In the case of cirrhosis with its risk of hepatic coma, the bleeding must be arrested promptly, the blood removed from the intestine, and the formation of ammonium compounds inhibited with neomycin. If the Sengstaken-Blakemore tube fails, transesophageal ligation of the varices must be performed. In the extrahepatic form of portal hypertension prolonged preparation is not needed and a splenorenal anastomosis can be made as soon as the patient's condition permits.

The technique of performing portacaval and splenorenal shunts is presented, and the details of postoperative care are given. An illustration of an end-to-side anastomosis between the inferior vena cava and the superior mesenteric vein is shown and Nuboer is said to have obtained good results with this operation in patients who had previously undergone splenectomy.

The mortality rate in this series was 14.8 per cent for the patients operated upon for intrahepatic portal hypertension; none of the group with extrahepatic portal hypertension died. Recurrent hemorrhage occurred in 11.1 per cent of the patients with portacaval shunts and 23.5 per cent of those with splenorenal shunts who survived operation. No failures occurred when the anastomosis was 1 cm. in diameter or greater. Regardless of the type of anastomosis, there was no aggravation of the clinical condition. Although there was often a slight impairment of liver function during the first 10 days after operation, restoration to the preoperative condition occurred within a few weeks in all patients. The author believes that the portacaval anastomosis affords the best chance of permanently reducing the pressure in the portal system. In cases of extrahepatic portal hypertension, a splenorenal shunt is much preferred to esophagogastrectomy.

—*James J. Mongé.*

The Roentgenographic Findings in Cases of Gastric Biliary Calculi. NEILL B. LONGLEY and ALEXANDER R. MARGULIS. *Surgery*, 1961, 49: 719.

INTRAGASTRIC gallstones are uncommon, especially is it uncommon for them to be demonstrated roentgenographically. A few intramural and intragastric gallstones have been roentgenographically demonstrated and reported. Intragastric gallstones are caused by the penetration of a gallstone through the wall of the gallbladder or common duct and subsequent migration of the stone into the stomach in either an intramural or intraluminal position. The perforation of the gallbladder or common bile duct may be preceded by cholecystitis and occasionally by cholangitis and gangrene of the wall of the gallbladder or, uncommonly, of the common duct. An inflammatory mass incorporating the stomach, duodenum, bile ducts, and gallbladder is usually formed. A stone may migrate directly to the stomach or may be passed in retrograde fashion from the duodenum to the stomach.

The roentgenographic features of gastric biliary calculi are closely akin to those of spontaneous internal biliary fistula. Gas or contrast material is found in the biliary tree. Air enters the biliary tract from the stomach or other hollow viscera and the biliary tree is outlined against the homogeneous liver density. The absence or change in position of a previously demonstrated gallstone is of value. Pyloric obstruction due to a gallstone is the same as for any other cause. The demonstration of calculi in the stomach is readily obtained by ingestion of contrast material. This procedure will also aid in the demonstration of an intra-

mural stone which appears as a mass in the stomach over which the mucosa is intact. Two cases are presented: 1 of intraluminal gastric gallstones and 1 of the intramural type. —*Frank L. Hussey.*

Examination of the Serum Ferment Activity in Surgery of the Biliary Tract (Untersuchungen ueber Serumfermentaktivitaeten in der Chirurgie der Gallenwege). H. J. THUM. *Langenbecks Arch. klin. Chir.*, 1961, 297: 91.

TO DIAGNOSE biliary obstruction, the estimation of serum glutamate pyruvate transaminase (SGPT), serum lactate dehydrogenase (SLDH), and alkaline phosphatase has been quite helpful. In cases of yellow jaundice due to obstruction caused by carcinoma the serum glutamate pyruvate transaminase as well as the serum lactate dehydrogenase were markedly higher than in obstruction caused by stones. In differential diagnosis for cirrhosis of the liver the estimation of alkaline phosphatase has been very informative. The level of alkaline phosphatase will be markedly elevated in cases of obstruction in contrast to cirrhosis.

The postoperative rise of the serum activity varies. This variation may be due to the different operative sites. Operation on the bile ducts results in a rise in the lactate dehydrogenase and in the fructose-l-phosphate allodase which does not occur in other operations of the abdominal cavity. It is thought that this rise may be due to direct trauma to the liver at the time of operation. —*Frank R. Lichtenheld.*

Diagnosis of Internal Biliary Fistula (Zur Diagnose innerer Gallenfisteln). H.-H. DOMKE. *Fortsch. Röntgenstrahl.*, 1961, 94: 608.

THE AUTHOR reports 31 cases of internal biliary fistulas which were found during routine examinations in 6 years. Eighteen of these fistulas appeared spontaneously. The most common cause of fistula was perforation by gallstones, the second most common was carcinoma, and the third inflammatory processes arising from the biliary tract. Only 1 fistula due to penetrating duodenal ulcer was found without air filling of the biliary system. The other 30 cases showed some degree of air filling.

Clinically the symptoms were extremely diverse. In cases of carcinoma the symptoms were chronic but had an insidious course, whereas in perforation due to gallstones they were characterized by acute and transient episodes. On 2 occasions the author observed filling of the ducts with air as well as with contrast medium, the common bile duct terminating in a diverticular protrusion of the duodenal mucosa.

—*Frank R. Lichtenheld.*

Acute Cholecystitis; Its Etiology and Course, with Special Reference to the Timing of Cholecystectomy. Y. EDLUND and O. OLSSON. *Acta chir. scand.*, 1961, 120: 479.

A STUDY was made of 8,368 operations on the biliary tract at the Sahlgrenska Sjukhuset, Göteborg, Sweden.

The concept of two types of chronic cholecystitis, one succeeding from an attack of acute cholecystitis, called secondary chronic cholecystitis, and one with stones and little thickening of the wall and little inflammatory reaction, called primary chronic cholecystitis, is presented.

The occurrence of gallbladder disease in a fairly stable and sizable population is analyzed from these cases and the presence of a sex linked factor for gallstones thus postulated. Little evidence that bacterial infection played a significant role in gallstone disease could be found. Its only great significance was in acute cholecystitis with perforation.

It is pointed out with good pathologic and clinical data for support that operation is best performed after 2 to 3 days and before 7 days from the onset of the acute episode.

This is an excellently studied and analyzed group of cases, which, while perhaps not bringing forth new data, offers evaluation and unification of many random concepts about gallstone disease.

—*Robert W. Williams.*

Primary Carcinoma of the Gallbladder. PAUL H. GERST. *Ann. Surg.*, 1961, 153: 369.

IN THE 30 YEAR PERIOD from 1930 to 1959, 132 patients with primary carcinoma of the gallbladder had the diagnosis confirmed at operation at the Columbia University-Presbyterian Hospital Medical Center, New York City. The results reported are unsatisfactory; only 5 per cent of the patients survived for 5 years after operation. However, of 22 patients who underwent cholecystectomy and in whom the tumor was thought to have been completely excised, there are now 7 long term survivors, i.e., 32 per cent.

Carcinoma was found to occur in 1.8 per cent of patients with cholelithiasis who were operated upon for disease of the gallbladder. Of those patients in whom a reliable determination could be made, 89 per cent had associated calculi of the biliary tract. It was concluded that the risk of the development of carcinoma, added to the other potential complications of gallbladder calculi, justified early cholecystectomy in an otherwise healthy, good risk patient with cholelithiasis. —*W. Foster Montgomery.*

Gallbladder Carcinoma (Das Gallenblasenkarzinom). A. SCHNEIDERBAUR and E. LHOTKA. *Wien. med. Wschr.*, 1961, 111: 331.

GALLBLADDER CARCINOMA remains in the background despite its frequent occurrence. The authors found 92 cases in a period of 20 years. This number constituted 1.07 per cent of all autopsies and 5.8 per cent of the total number of patients who died of carcinoma. The average age of the patients was 71 years, with a 3 to 1 relationship between the number of women and men affected. In 87.17 per cent of the autopsies a simultaneous occurrence of cholelithiasis was noted. The relationship of gallbladder carcinoma to cholecystopathy was calculated to be 2.47 per cent. With the exception of the last percentage, the authors' statistics coincide with those noted in recent literature. This difference is significant because Bauer, who has found a percentage of 5.8, holds that cholelithiasis is a genuine precancerous factor with a risk of 1 to 17 and that the operative procedure represents a prophylactic measure. Other authors maintain that the simultaneous appearance of carcinoma and calculi is not indicative of primary formation of stones and the secondary

appearance of carcinoma, but that the calculi are secondary to break down products and stagnation caused by the carcinoma.

Successful operation in early carcinoma is the result of accidental discovery. The authors believe that if any relationship exists between gallbladder carcinoma and gallbladder affections, there still is no clear etiologic factor between biliary calculi and carcinoma. The authors conclude that early cholecystectomy is warranted in chronic gallbladder disease even if its etiologic relationship to gallbladder carcinoma cannot be fully and completely substantiated.

—*Andrew P. Adams.*

Indications for Choledochostomy in Operations for Cholelithiasis. GEORGE M. SAYPOL. *Ann. Surg.*, 1961, 153: 567.

A TOTAL of 525 patients having operations for cholelithiasis was studied. Results suggest that commonly accepted indications for choledochostomy are not dependable and that careful palpation of the common duct may prevent unnecessary choledochostomies.

The average diameter of the common bile duct in 94 patients with cholelithiasis but without duct stones was 9.7 mm. The average diameter of the common bile duct in 13 patients with cholelithiasis with duct stones was 16.2 mm. Common duct stones may be present in ducts of small caliber, less than 10 mm., and they may be absent in ducts of large caliber, 12 to 15 mm.

Serum amylase levels were determined 18 to 24 hours after operative cholangiograms in 84 patients. Although the level was elevated in 6 patients, only 1 of these patients had symptoms and signs of acute pancreatitis.

Cholangiographic equipment should be available for all patients undergoing operations on the biliary tract. The need for its use will diminish as one's experience in palpating the bile ducts for stones increases. The author describes his method of palpating the common duct over an inserted catheter.

—*Ernest D. Bloomenthal.*

Strictures of the Common Bile Duct and Ampulla. JAMES A. KIRTLEY, JR., and ROBERT W. YOUNGBLOOD. *Ann. Surg.*, 1961, 153: 725.

THIS REPORT deals with 91 consecutive patients having a stricture or stenosis of the bile duct. The first group consists of 23 patients who had a stricture of the common duct or the common hepatic duct. In another group there were 68 patients with stenosis of the duodenal papilla who required sphincterotomy in addition to other procedures. The differences in clinical and laboratory findings between ampullary stenosis and common duct stricture are enumerated. With ampullary stenosis, jaundice is rare unless there is associated choledocholithiasis or cholangitis whereas with common duct stricture it is frequently the presenting symptom. Dilatation of the common duct is infrequently seen in uncomplicated ampullary stenosis. Ampullary stenosis may be the elusive diagnosis even with normal results of laboratory examination of liver function, excellent function demonstrated by cholecystography and a grossly normal gall bladder at operation. The authors are so impressed with the part played by ampullary stenosis that they state the "postcholecystectomy syndrome" is due to ampullary stenosis. They recommend transduodenal sphincterotomy, at which time a cholecystectomy is also carried out.

From their study of 23 patients with bile duct strictures followed up for 13 months to 10 years, they conclude that a modified technique of Roux-en-Y hepatocholangiojejunostomy has given better results than other recommended procedures.

—*Gordon F. Madding.*

Splenic Vein Disease in Association with Cysts of the Pancreas (L'atteinte de la veine splénique au cours et au décours des faux kystes du pancréas). LUCIEN LEGER, MICHON, and BAKALOUDIS. *J. chir.*, Par., 1961, 81: 15.

SPLENOMANOMETRY and splenoportography are important diagnostic measures in dealing with lesions of the pancreas, particularly tumors and cysts. Splenoportography can also be used to determine the status of the portal circulation after certain operations on the pancreas.

A case is reported in which a pancreatic pseudocyst was treated by drainage. Subsequently drainage was stopped and the patient remained well. Later an enlarged spleen was discovered on a routine physical examination. The explanation was a thrombosed splenic vein which could not be visualized by means of splenoportography.

A second case is reported in which a 48 year old man complaining of pain in the epigastrium was studied by splenomanometry and splenoportography. Splenic pressures were normal but splenoportography showed a pseudocyst of the pancreas. The cyst was satisfactorily treated by anastomosis of the cyst to the stomach.

Patients with pseudocysts of the pancreas who experience a continuation of pain after surgical drainage may have lesions which can be detected by splenoportography.

Two cases are reported of patients with persistent symptoms after drainage of pseudocysts. Extensive collateral channels and failure of the splenic vein to visualize indicated that thrombosis of the structure had occurred in both patients. One patient was reoperated upon and obtained a good result after removal of stones from the duct of Wirsung.

In 1 patient splenomanometry revealed a pressure of 45 mm. of water. Six months after internal drainage of a pseudocyst by cystogastrostomy the pressure fell to 13 mm. of water.

Splenectomy and distal pancreatectomy may bring relief of symptoms in patients with thrombosis of the splenic vein which occurs in association with pseudocyst of the pancreas, according to the authors.

—*Frederick W. Preston.*

Accessory Pancreas in the Stomach and Duodenum. OLE EKLÖF. *Acta chir. scand.*, 1961, 121: 19.

THE AUTHOR reports a series of 16 men and 9 women with accessory pancreas in the stomach or duodenum. There was no evidence that the accessory pancreas produced symptoms, as these were usually caused by some other pathologic process. Therefore an accessory

pancreas diagnosed roentgenographically in patients with abdominal symptoms should never be accepted as the cause of symptoms without further examination.

The characteristic roentgen appearance is diagnostic. In a small percentage of cases malignancy cannot be ruled out roentgenographically. Since uncomplicated accessory pancreas is asymptomatic, expectant therapy is justifiable.

In cases of long-standing symptoms without any other apparent cause, the indications for operation are relative whereas in cases in which malignancy is suspected, and in those with clinical evidence of insulinoma, the indications for operation are imperative.

—*Ernest D. Bloomenthal.*

SPLEEN

Peritoneal Splenosis (La splénose péritonéale). F. Cabanne, C. Ferry, F. Pansiot, and P. Rougemont. *Presse méd.*, 1961, 69: 1263.

The authors present case histories of 3 patients with peritoneal splenosis and review the literature on this subject. Their 3 patients were women. Each had undergone prior splenectomy after traumatic rupture, 10, 17, and 15 years, respectively. The diagnosis of splenosis was made in 2 patients at the time of laparotomy for other disease; the third patient was to be operated upon because of gynecologic symptoms, attributed preoperatively to endometriosis and found to be due to pelvic splenosis. The number of splenic implants in these 3 patients ranged from 7 to an estimated 200.

The volume, number, and localization of the splenic nodules vary considerably. The size may be that of a raisin or that of the large toe. The number ranges from as few as 6 to as many as 400. Any peritoneal surface may be implanted, especially small intestine, greater omentum, parietal peritoneum, large intestine, mesentery of the bowel, and pelvic genitourinary structures. The nodules possess the architecture of normal or near normal spleen; their color varies from pink to greenish black.

The pathogenesis of autoplastic splenic transplants is not clear. There are two theories: (1) compensatory postsplenectomy hyperplastic response of previously quiescent accessory spleens. The arguments against this hypothesis are that the patterns of implantations are often at variance with embryologic sites of predilection, and that the architecture is histologically different from that of accessory spleens. (2) traumatic dispersion of splenic tissue and "autograft takes." This is the most widely accepted theory.

The authors urge that every precaution be taken against leaving behind bits of splenic tissue at the time of splenectomy. Operation for splenosis per se is not indicated.

—*Edwin J. Pulaski.*

SURGERY OF THE FEMALE REPRODUCTIVE SYSTEM

UTERUS AND ADNEXA

A Study of the Quantitative Characteristics of Exfoliated Cells from the Female Genital Tract. W. E. Tolles, W. J. Horvath, and R. C. Bostrom. *Cancer*, 1961, 14: 437, 455.

The authors reported the quantitative measurement of 3 characteristics of cells exfoliated from the cervix and vagina of more than 500 patients distributed in age and in cytologic classification—some 560,000 datum points.

Observations were made about the effects on the quantitative characteristics of the cells, of variations in the method of cell collection, the part of the menstrual cycle when cells are collected, and the age of the patient. A method of analysis, assembly, and display of the characteristics of the cell population of a cytologic specimen in terms of the percentage of cells with specified values of cell diameter, nucleus diameter, and nucleus density was developed and its descriptive value was shown. From the study of the distribution of cell measurements, the following conclusions were drawn:

1. Normal cells exhibit a functional relationship between the size and the density of the nucleus that approximates a theoretical relationship which suggests that the nucleus contains a constant quantity (Q) of dye-binding material throughout the stages of differentiation.

2. Normal smears of the postmenopausal atrophic type show a different distribution from the premenopausal ones. This is characterized by a marked increase in the number of cells with large, lightly stained nuclei and low cell to nucleus (C/N) ratios and a corresponding decrease in the number of cells with densely stained, small nuclei and large C/N ratios.

3. There is a continuous spectrum of change toward increased hyperchromasia and decreased C/N ratios as one progresses from normal to benign atypia to cancer smears.

4. The smear groups classified as being associated with cancer, including carcinoma in situ, distinctly show the presence of a second population of aberrant cells superimposed on the normal cell population.

The display of quantitative cytologic data in this fashion gives the investigator a reproducible method of showing his results, a quantitative basis of intercomparison, and an easy means of assessing relative populations of the cells of various stages of differentiation of the vaginal and cervical preparations. Cytologists have known that hyperchromasia and small C/N ratio were characteristic of aberrant cells. The data presented express these statements in quantitative terms and show numerically the changes in the cell population distributions brought about by cancer.

The differences between the smears of normal individuals and those of patients with cancer appear highly significant and suggest the possibility of using these quantitative measurements as criteria for automatically prescreening a large population for cancer.

The quantitative properties of cells used in this study—nucleus diameter, nucleus extinction coefficients, and cell to nucleus diameter ratio—can all be used for screening. The collection method and menopausal status, however, do influence the screening performance.

The screening performance for vaginal smears (premenopausal) at 5 per cent false negative smears is 65 per cent false suspicious, a screening level of questionable value.

The screening performance for cervical smears (premenopausal) at 5 per cent false negative smears is 40 per cent false suspicious, a useful but not particularly impressive screening level.

The screening performance for cervical scrapings (premenopausal), because of the abundance of aberrant cells, permits reducing the false negative smears to essentially zero with false positive smears on the order of 15 per cent—a very effective screening level.

Postmenopausal smears that showed marked atrophic changes have screening levels that are less useful than those of the premenopausal smears. At 5 per cent false negative smears, the cervical swabs have 55 per cent false suspicious smears and the cervical scrapings have 35 per cent false suspicious smears.

—*Charles Baron.*

The Colpomicroscope, Auflichtmikroskop, in the Diagnosis of Benign and Premalignant Lesions of the Cervix Uteri. Ting-Chao Wong, James H. Austin, Paul A. Younge, and Donald G. McKay. *Obst. Gyn.*, 1961, 17:665.

Of 100 specimens taken from abnormal cervices and evaluated by cytology, colpomicroscopy, and histology, 83 were ultimately benign, giving an accuracy of diagnosis of 100 per cent by cytology and histology and 95 per cent by colpomicroscopy. Seventeen were ultimately found to be either anaplasia or carcinoma in situ, with an accuracy of 100 per cent by cytology, 88 per cent by initial biopsy, and 82 per cent by colpomicroscopy.

It is hoped that colpomicroscopy, with its ability to reveal cellular detail in vivo, will provide useful information on the pathogenesis of cervical cancer.

—*John R. Wolff.*

Intrauterine Isotopes in Menorrhagia. H. C. McLaren. *J. Obst. Gyn. Brit. Commonwealth*, 1961, 68: 205.

Simple recurrent menorrhagia in the fourth decade of life is usually treated in the author's unit by hysterectomy with ovarian conservation. Treatment with Sr^{90} is an alternative although it offers a cure rate of only about 50 per cent.

After a pilot experiment in which P^{32} was used as an endometrial cautery with only a 3 month follow-up before hysterectomy, intrauterine isotopes were used in 33 patients with recurrent menorrhagia after curettage which was considered severe enough to require hysterectomy. Intrauterine isotopes, P^{32}, Sr^{90}, cured 16 patients, of whom 6 reached the menopause.

The method appears to have a small but definite place among the therapeutic methods available for simple menorrhagia; it is recommended only after failure of conservative therapy.—*John R. Wolff.*

Abnormal Uterine Bleeding Subsequent to Pelvic Surgery. KENNETH R. BALDWIN and WILLIAM A. MANSON. *South M. J.*, 1961, 54: 627.

A HISTORY of tubal ligation seems to be ten times more common in a group of patients with functional uterine bleeding than in the population as a whole. Patients with a history of previous pelvic surgery have abnormal bleeding for a longer period of time before admission to the hospital than do patients without such a history. Indications for pelvic surgery, especially tubal ligation and cesarean section, should be reappraised in view of this increased incidence of late complications. Serious consideration should be given to the thesis that patients should be sterilized by hysterectomy rather than by tubal ligation because of the late complications accompanying the latter procedure. —*Charles Baron.*

Review of 36 Shirodkar Operations. JOSEPH R. BRANDY and JOHN H. PETERSON. *Am. J. Obst. Gyn.*, 1961, 81: 1191.

IN 169 PREVIOUS PREGNANCIES a group of 35 mothers had produced but 26 surviving children for a fetal salvage of only 15.3 per cent. Only 1 patient had produced a live child as a result of her last pregnancy, i.e., the one immediately preceding the pregnancy in which the Shirodkar procedure was performed. After suture-closure of the cervix among 36 pregnant patients, 23 pregnancies resulted in the birth of a surviving child, a fetal salvage of 63.9 per cent.

It appears that patients who have a history of repeated first trimester abortion or a history of premature separation of the placenta and second trimester abortion are not likely to be successful candidates for this operation. This operation is indicated when effacement, beginning dilatation, and visualization of membranes occur in the absence of bleeding and pain in the second trimester. It is indicated when, in a previous pregnancy, spontaneous rupture of the membranes has occurred in the second trimester without bleeding and pain. —*Charles Baron.*

Management of Early Carcinoma. J. GEORGE MOORE, DANIEL G. MORTON, JOHN W. APPLEGATE, and WILLIAM HINDLE. *Am. J. Obst. Gyn.*, 1961, 81: 1175.

TWO HUNDRED AND EIGHTY-FIVE PATIENTS from the obstetric and gynecologic services of a number of hospitals who were thought to have early, usually subclinical, cervical cancer were subjected to cervical conization. Positive or repeated suspicious results had previously been obtained from vaginal cytologic study or biopsy had indicated intraepithelial carcinoma in these patients. The age range was 19 to 87 years, with the largest group falling in the age decade 30 to 39 years. Thirteen per cent were nulliparous and 12 patients were pregnant when the conization was performed.

After review of the conization sections, the patient was either followed up, subjected to total hysterectomy, or given irradiation therapy. When frankly infiltrative carcinoma was found, or if lymphatic channels were seen to be involved in the cone specimen, a radical hysterectomy and pelvic lymphadenectomy or full cancerocidal irradiation was prescribed and carried out.

Systematic investigation of the conization specimens revealed 28, 10 per cent, were stage I cervical cancers; 156, 55 per cent, intraepithelial or superficially invasive (microinvasive) cancers; and 37, 13 per cent, severe squamous atypias. There were 64 cases, 22 per cent, of chronic cervicitis, reserve cell hyperplasia, or other conditions.

For purposes of therapy the 68 patients with superficially invasive squamous cancers were grouped with the truly intraepithelial cancers as stage 0. Of the 156 patients with stage 0 cervical cancers, 30, 19 per cent, were treated by conization alone, 9, 6 per cent, by irradiation because they were either poor risk patients or postmenopausal, and 117, 75 per cent, underwent hysterectomy. Residual cancer was demonstrated in 30 per cent of the hysterectomy specimens. If the lesion was not designated as cleared up by the conization, 45 per cent residual cancer was demonstrated.

Stage 0 cervical cancer can be effectively treated by simple total hysterectomy, irradiation restricted to the cervix, or conization alone. The authors state that the preferred therapy of stage 0 cancers is total extrafascial hysterectomy or, occasionally, local irradiation of the cervix. Conization has a definite place in stage 0 cervical cancer in young patients and in those who wish to preserve their child-bearing function. However, if the definitive treatment is restricted to conization alone, adequate follow-up, including vaginal cytology, must be assured.

—*Lawrence I. Bernard.*

Recent Cure Results of Cervical Cancer in Our Clinic. KOHACHIRO KOGA, SUSUMU IZUCHI, and MAMORU YAMADA. *Kyushu J. M. Sc.*, 1960, 11:217.

ONE THOUSAND FOUR HUNDRED AND FOURTEEN patients with cervical cancer were treated in the Kyushu University Clinic, Fukuoka, Japan during the 8 years from 1947 to 1954.

The absolute 5 year cure rate—counting those lost to follow-up as dead from cancer—for patients treated with radical hysterectomy and postoperative deep radiation therapy was: stage I, 79.5 per cent; stage II, 54.2 per cent; and stage III, 37.7 per cent. There was no difference in the cure rates of the patients treated by irradiation alone compared with those of the patients treated by surgery plus irradiation. The over-all absolute cure rates were: stage I, 78.0 per cent, 118 cases; stage II, 54.6 per cent, 302 cases; stage III, 25.8 per cent, 511 cases; and stage IV, 3.5 per cent, 115 cases. —*Alan Rubin.*

The Management of Recurrent Carcinoma of the Cervix Following Simple Total Hysterectomy. WILLIAM W. DANIEL and ALEXANDER BRUNSCHWIG. *Cancer*, 1961, 14:582.

BETWEEN September 1947 and January 1955 at the Gynecologic Service of the Memorial Center for Cancer, New York City, 78 patients were seen with recurrence of cancer of the cervix after total panhyster-

ectomy. Sixty of the 78 patients had received radiation after the operation. The interval after hysterectomy and before the patients were seen in the Memorial Center ranged from 5 months to 10 years, with all the intervals in all but 5 cases being less than 3 years.

Forty-two had such extensive recurrences that no operation, no matter how radical, could have achieved cure. Limited operations for recurrences afforded 5 year salvage in 10 of 12 instances. Of 33 patients having exenterations for extensive recurrences, 7 survived free from disease for at least 5 years.

When recurrences manifest themselves after panhysterectomy for cervical cancer, prompt surgical intervention is indicated. The type of procedure depends upon the extent of the recurrence.

—*Alan Rubin.*

Intra-Arterial Infusions of Pelvic Tumors with Amethopterin. JOHN J. CAHILL and PAUL R. ZEIT. *Am. J. Obst. Gyn.*, 1961, 81: 970.

THIS STUDY reports an attempt made to provide a continuous and prolonged cytotoxic effect on the tumor with minimal effects on the host.

The tumors chosen for this study involved the cervix, corpus, and vagina because (1) the infusate could be injected into 2 arteries from which most of the blood goes to the tumor area; (2) the vessels were readily accessible; and (3) the vessels could be sacrificed if necessary.

The drug chosen was amethopterin, methotrexate, a folic acid antagonist which blocks the conversion of folic acid to folinic acid and hence prevents the production of nucleic acid.

The hypogastric artery is exposed transperitoneally and the posterior trunk is ligated. The anterior trunk is catheterized and arteriograms are taken to visualize the ultimate distribution of blood. A pump which delivers a constant slow flow of infusate is attached to the catheter, and the infusate used is 1 l. of 5 per cent dextrose in water containing 50 mgm. of heparin and 25 mgm. of amethopterin per 24 hours. At the same time citrovorum factor is given intramuscularly every 4 hours until 48 hours after the infusion is stopped. The latter factor is given only when toxic manifestations occur.

Six patients with recurrent pelvic cancer, all previously treated by surgery and/or radiation, were subjected to arterial infusion as described. The primary symptom in each was severe pain. Two patients had excellent subjective results; 2 had no response; 1 died as a result of therapy; and in 1 it was too early for evaluation. In no case did the tumor disappear.

The report is that of an experiment in which a technique has been accomplished that will allow high concentrations of cytotoxic drugs to be delivered to pelvic tumors. A drug that will destroy these tumors is now needed. —*M. Leon Tancer.*

The Clinical Value of Peritoneal Lavage for Cytologic Examination. DANIEL G. MORTON, J. GEORGE MOORE, and NORMAN CHANG. *Am. J. Obst. Gyn.*, 1961, 81: 1115.

FROM MARCH 1957 through June 1960, 288 peritoneal washings at laparotomy were examined cytologically to evaluate the diagnosis and prognosis of various gynecologic conditions, particularly ovarian tumors.

Positive or suspicious smears were found in 25 of 35 cases of pelvic tumors. The 10 false negative smears were associated with well confined tumors or metastatic tumors. Of 14 primary ovarian tumors 13 were associated with positive peritoneal smears.

Positive smears were obtained in 7 cases in which no malignant lesion existed clinically in the peritoneal cavity. In 4 of these cases the operation was for endometrial cancer and in 1 for cervical cancer; 2 cases were presumably errors of interpretation. Whether the cells from these tumors migrated into the abdominal cavity by way of the tubes or whether they were interpreted erroneously cannot be said with certainty.

Of 23 primary ovarian tumors which were externally smooth and freely movable, that is, clinically and grossly benign at operation, 21 were actually benign and there were no false-positive smears obtained in these cases. Of the 2 externally smooth, freely movable malignant tumors, 1 was associated with a positive peritoneal lavage smear and the other was not.

The authors state that this procedure has a certain diagnostic and prognostic value in relation to primary ovarian tumors which are externally smooth and freely movable, and the nature is questionable. The absence of malignant cells under such circumstances may indicate a good prognosis.

—*Lawrence I. Bernard.*

Pseudomyxoma Peritonei. H. G. I. SHANKS. *J. Obst. Gyn. Brit. Commonwealth*, 1961, 68: 212.

A CLINICAL AND pathologic study has been made of 13 cases of pseudomyxoma peritonei in women. Twelve cases were associated with pseudomucinous tumors of the ovary, 10 of which were benign and 2 were malignant. One case followed rupture of a mucocele of the appendix.

Pseudomyxoma peritonei is a rare complication of a pseudomucinous ovarian tumor and occurred in 3.5 per cent of 337 cases. The source of the jelly is partly the secretion of the leaking cyst and partly the epithelial implants scattered over the peritoneum. Other characteristic features of the disease are the result of attempts by the peritoneum to localize the jelly with the formation of dense adhesions and encapsulated collections.

Pseudomyxoma peritonei of appendicular origin is an even rarer disease. Yet the association of a pseudomucinous cyst and a mucocele of the appendix is not uncommon in pseudomyxoma peritonei in females and was found in 4 of the present series. The significance of this association is unexplained.

The treatment is surgical and the value of roentgenotherapy is not proved. Of the 12 patients with ovarian tumors studied, 4 died and 1 was not traced. In the patients who died, the ovarian lesion was malignant in 2 and benign in 2. In the 7 patients who have survived, 2 are alive with a recurrence of the disease, one 14 years and one 16 years after diagnosis. Five patients have survived without evidence of recurrence for periods varying from 6 months to 6 years. The patient who had rupture of an appendicular mucocele is alive and free of recurrence 3.5 years after operation.

The prognosis of pseudomyxoma peritonei complicating a benign mucinous cyst of the ovary is always doubtful. —*John R. Wolff.*

Surface Tumors of the Ovary. SAMUEL A. WOLFE. *Obst. Gyn.*, 1961, 17:719.

SURFACE TUMORS of the ovary are comprised of external neoplasms which arise from ovarian mesothelium, tunica, and cortex, and which extend geographically beyond the free surface of the organ. Surface tumors exist separately and/or in combination with benign and malignant intraovarian serous cystic neoplasms. Fibromas, adenofibromas, and papillomas are distinct pathologic types of surface tumors. They are often concomitant in the same ovary.

Benign surface papillomas associated with simple or papillary cystadenomas are independent exophytic tumors derived from the same epithelial and stromal substrates which give rise to the intraovarian growth. The finding of microscopic serous cystadenoma in the presence of separate and grossly established fibroma, adenofibroma, and papilloma supports this concept.

A new pathologic study of tumors comprised of conjoined surface papilloma and intraovarian serous cystic tumors is required. The removal of blocks of sufficient number and size to establish the anatomic and histologic relationship between the surface growths and the underlying intraovarian tumor segments is mandatory.

In papillary cystadenocarcinoma the origin of surface papillary carcinoma by perforation or direct tumor growth has been heretofore accepted. However, intraovarian papillary cystadenocarcinomas are often secondary, for they contain benign, "borderline," and malignant segments, indicative of the progressive neoplastic potential residing in the component tumor cells.

Proof of benign surface papillomas overlying a malignant loculus in "secondary" cystadenocarcinoma would establish the autochthonous position of surface tumors even when they are associated with benign or malignant intraovarian cystic neoplasms. —*John R. Wolff.*

EXTERNAL GENITALIA

The Nature of Vaginal Discharge. J. A. BOYCOTT. *Lancet*, Lond., 1961, 1: 1071.

A TOTAL of 595 specimens of vaginal discharge have been studied by the author in an attempt to determine whether the discharge was due to bacterial infection. In every case the patient's complaint was of a discharge which was excessive in amount, irritating, or offensive.

It was demonstrated that the presence of pus is associated fairly consistently with two other characteristics. Such discharges are, on the whole, less acid than the discharges with few or no leukocytes, and they rarely contain lactobacilli.

When the discharge contained little or no pus, it was, for the most part, indistinguishable from what is considered normal. Some discharges contained large numbers of yeastlike fungi and mycelia. The bacterial flora ranged from lactobacilli alone to a mixture of lactobacilli with micrococci, diphtheroid bacilli, vibrios, and coliform bacilli. No organism or group of organisms, except lactobacilli, was found to be associated habitually with any other element in the discharges nor were any of the bacteria commonly pyogenic in man ever found. In general, the flora consisting of lactobacilli alone was commonest in the younger women. With increasing age and repeated childbirth the proportion of other organisms increased and the *p*H tended to rise. At about the menopause the reaction became still less acid.

The purulent discharges showed quite a different picture. Over 90 per cent of these contained Trichomonas vaginalis. The bacterial flora accompanying this protozoon might be profuse or scanty, but always appeared to consist of the same species as were found in the discharges without pus. Lactobacilli were, however, seldom present.

The literature on the causes of vaginal discharge is for the most part confusing says the author. The proportion of patients harboring T. vaginalis in this series, 24 per cent, is much the same as that found by many other investigators. Twelve per cent of the discharges were attributed to Candida albicans, which is less than the figure usually given. The most obvious divergence of this series from others is in the large number of women, 62 per cent, with a discharge which differed only in quantity from normal vaginal secretions and which could not be attributed to any extraneous cause. —*Ely Elliott Lazarus.*

PREGNANCY AND COMPLICATIONS

Serum Isocitric Dehydrogenase in Normal and Abnormal Pregnancy. M. J. R. DAWKINS and J. S. WIGGLESWORTH. *J. Obst. Gyn. Brit. Commonwealth*, 1961, 68:264.

SERUM ISOCITRIC DEHYDROGENASE LEVELS do not alter in normal pregnancy nor in pregnancy complicated by essential hypertension or mild pre-eclampsia. Transient elevations of serum isocitric dehydrogenase occur in cases of severe pre-eclampsia at the time of fairly sudden clinical deterioration. Elevations are also found in cases of placental abruption and in women with previous stillbirths. It is suggested that placental infarction is the source of this enzyme. —*Alan Rubin.*

The Clearance of Radioactive Sodium from the Myometrium of the Pregnant Diabetic. J. M. BRUDENELL, JULLIAN M. MILES, and ANN COLEMAN. *J. Obst. Gyn. Brit. Commonwealth*, 1961, 68: 238.

THE MYOMETRIAL BLOOD FLOW in late pregnancy was estimated by the radioactive sodium clearance technique in 68 diabetic and 26 nondiabetic patients. In the diabetic patients the estimation was repeated on 2 or 3 occasions at fortnightly intervals.

No difference was demonstrated in the mean clearance times between the diabetic and nondiabetic groups. Mild pre-eclampsia did not adversely affect the clearance time in either group.

In the diabetic patients there was no increase in clearance time with increasing maturity; neither was there any correlation between the clearance time and hydramnios or maternal weight. The clearance time in those patients whose infants were stillborn, died in

the neonatal period, or recovered from the pulmonary syndrome was faster than in the patients whose infants survived uneventfully. There was a similar correlation, implying increased myometrial/placental blood flow, in the clearance times of those patients with a high dosage of insulin at the end of the pregnancy.

In spite of a wide variation between successive determinations in the same patient this variation was less than that between patients. The test was not found to be of any prognostic value in the individual diabetic patient as regards fetal outcome.

No evidence was found to support the idea that maternal placental blood flow is impaired in pregnant diabetics. The explanation for the increased fetal loss in this condition must therefore lie elsewhere.

—*John R. Wolff.*

The Detection of Fetal Erythrocytes in Blood Smears. W. C. TAYLOR and G. KULLMAN. *J. Obst. Gyn. Brit. Commonwealth*, 1961, 68:261.

BLOOD SMEARS from blood donors and from antepartum and postpartum mothers have been examined for the presence of fetal erythrocytes by a technique similar to that described by Zipursky and his colleagues in 1959. Blood smears were positive for fetal erythrocytes in 2 out of 100 blood donors. One of the donors was a 47 year old female in good health at the time of donation. The other donor was a 51 year old male suffering from polycythemia vera who was donating blood at weekly intervals.

The blood smears from 18 per cent of 40 antepartum mothers, and from 17 per cent of 58 postpartum mothers were positive for fetal erythrocytes. In the postpartum group, the highest incidence of positive smears occurred in primiparous patients after forceps delivery. No fetal erythrocytes were detected in postpartum blood smears from 7 patients delivered by cesarean section.

These observations suggest that the presence of fetal erythrocytes in the circulating blood is not restricted to the newborn infant or to the postpartum mother. The term "fetal erythrocyte" should be used with reference to the morphology of the cell, which depends on its content of fetal hemoglobin.

—*Alan Rubin.*

Studies of the Isolated Perfused Human Placenta—I, Method and Organ Responses. R. JONATHAN GOERKE, CHARLES M. MCKEAN, ALAN J. MARGOLIS, MARY BETH GLENDENING, and ERNEST W. PAGE. *Am. J. Obst. Gyn.*, 1961, 81:1132.

BECAUSE the placenta is relatively inaccessible during pregnancy, a number of investigators have used isolated perfusion of the placenta for the study of its functions. It has been possible thereby to measure oxygen consumption, vascular dilatation and constriction, gas transfer, synthesis, and other metabolic processes.

The authors have devised a method of study in which a placenta evacuated of fetal blood is perfused under nearly physiologic conditions with a special fluid containing tissue culture medium, albumin, glucose, electrolytes, and antibiotics. Fetal cord blood was found to be unacceptable for perfusion because of early capillary obstruction.

During periods up to 12 hours, the rate of glucose utilization was constant at about 1 gm./kgm./hour. Production of organic acids caused a steady rise in hydrogen ion and potassium concentration. Hypoxia resulted in vasodilatation, and high oxygen concentration resulted in vasoconstriction. The fetal circulation was unresponsive to epinephrine or norepinephrine, but highly responsive to serotonin and histamine. Bilirubin conjugation with gluceronic acid was not observed.

—*Lester T. Hibbard.*

Studies of the Isolated Perfused Human Placenta—II, Progesterone Content of Perfusates. C. A. WOOLEVER, ALLAN GOLDFIEN, and ERNEST W. PAGE. *Am. J. Obst. Gyn.*, 1961, 81:1137.

THE AUTHORS have studied the progesterone content of placental perfusate, utilizing a method of perfusion developed at the University of California. After full term placentas were perfused from 2 to 12 hours, the progesterone content of the perfusate was greater than could be accounted for by simple extraction of preformed steroid. It is suggested that the excess represents progesterone synthesized during perfusion.

—*Lester T. Hibbard.*

Localizing the Placenta with Radioactive Iodinated Human Serum Albumin. FRED C. HEAGY and DONALD P. SWARTZ. *Radiology*, 1961, 76:936.

PLACENTAL LOCALIZATION by means of radioactive isotopes has one advantage over most roentgenographic techniques in that it can be accomplished with far less radiation exposure. The injection of as little as 3 microcuries of radioactive iodinated human serum albumin into the maternal circulation produces a pool of radioactivity in the placental lake which can be plotted by means of a scintillation detector. Anterior, fundal, and lateral placental attachments are readily located. Posterior attachments are located by exclusion because of an absence of a radioactive pattern.

Unfortunately, low implantation of the placenta is difficult to interpret. Since the method does not reveal the relationship between the internal cervical os and the placental margin, it does not clearly differentiate between placenta previa and a low-lying placenta.

—*Lester T. Hibbard.*

Placental Changes in Early Spontaneous Abortion. ARIE SADOVSKY and ALEXANDER LAUFER. *Obst. Gyn.*, 1961, 17:678.

TISSUE obtained from curettage and spontaneously aborted tissue from 681 spontaneous abortions in the first trimester of pregnancy were examined. In 269 cases only decidua was found. Of 412 cases in which decidua and placenta were found 389 were cases of accidental abortion and 23 were cases of habitual abortion. As control material for the histologic examination, tissue from 52 cases of therapeutic abortion was studied. The cases of spontaneous abortion of normal embryos were divided into stages according to the histologic evidence.

The histologic picture of the placenta in abortions of stage 1 was similar to that of the placenta in therapeutic abortion. In most villi both trophoblastic layers were present and there were numerous syncytial

buds. The stroma had a honeycombed appearance, sometimes with mild proliferation of stromal cells, and vessels were usually present.

The cases in stage 2 were characterized by an absence of capillaries in the villi and an absence of normal honeycombed stroma; however, there was usually proliferation of the stromal cells. The Langhans' layer was either completely absent or only a few of its cells remained. The syntrophoblast remained almost unchanged. The intervillous spaces were empty or contained red cells. In many cases of this stage, infarcts were also present. The infarcted areas showed intervillous spaces containing coagulated blood. The villi were fibrotic, anuclear, and avascular, and the two trophoblastic layers were absent.

In the cases in stage 3 the villi had a fibrotic, avascular stroma covered with syncytium in which abundant nuclear clumps occurred. In some cases, in which abortion was delayed for unusually long periods, the syncytial layer had been replaced by a fibrous layer investing a hyaline villus. The intervillous spaces were more or less filled with maternal blood, which probably had maintained the life of the syncytium. Such areas were occasionally very small, involving only 1 to 3 villi, and were like oases in a desert of infarcted areas. The infarcted areas were similar to those of the placentas of stage 2. Out of the 100 cases in this group there were 30 with such infarcted areas. —*John R. Wolff.*

The Clinician's Dilemma: Conization for Evaluation of Carcinoma in Situ of the Cervix in Pregnancy. JOHN R. BOTTOMY and RICHARD A. BOYD. *South. M. J.*, 1961, 54: 584.

CARCINOMA IN SITU is just as definite an entity in the gravid as in the nongravid state, despite the histologic obstacles in making a positive diagnosis. Ruling out the possibility of invasion is even more important in the gravid than in the nongravid patient, because of the decreased 5 year survival rate if such a lesion is overlooked during the prenatal period. Conization of the cervix offers the best means of obtaining adequate tissue for evaluation. The incidence of abortion and hemorrhage resulting from conization does not appear to prohibit this procedure. The incidence of invasion, of 28.6 per cent, though undoubtedly invalid because of the number of cases involved, makes this procedure valuable in detecting early invasive lesions.

—*Charles Baron.*

The Use of Stainless Steel Wire in the Treatment of Cervical Incompetence. GAVIN BOYD. *Proc. R. Soc. M.*, Lond., 1961, 54: 303.

STAINLESS STEEL WIRE, 34SWG, was used for suture in 56 patients with a diagnosis of cervical incompetence. The diagnosis was made solely on a history of 2 second trimester abortions or premature deliveries, eliminating missed abortions, and without benefit of roentgenography or other means.

Two sutures were commonly used, one at the level of the internal os and one slightly higher. These were inserted between the twelfth and fourteenth weeks of pregnancy and removed at the thirty-sixth week. A success rate of 76 per cent was obtained.

—*M. Leon Tancer.*

Pre-Eclampsia and Eclampsia—Results. LANCE TOWNSEND. *Med. J. Australia*, 1961, 1:553.

THE AUTHOR presents the statistics of the Royal Women's Hospital in Melbourne, Australia, for the period from 1939 to date. His succinct article presents the following conclusions:

1. That the incidence of eclampsia has been reduced. This reduction has occurred since 1944.

2. The severity of eclampsia is less as judged by a fall in maternal and perinatal mortality. The improvement in perinatal mortality since 1949 has been small.

3. The same remarks regarding incidence and severity apply to severe pre-eclampsia.

4. When antenatal care is instituted before 20 weeks' gestation, the incidence of eclampsia and of severe pre-eclampsia is less than when such care is commenced after this time.

5. The author states that modern methods do not reduce the over-all incidence of pre-eclampsia. They do, however, reduce the severity of the disease and delay its onset.

6. The author contends that the time has come to analyze critically our current methods of treatment and to assess the relative values of antenatal care, high protein reduction diet, salt restriction, diuretics, and bed rest.

Some or all of these methods of treatment have produced the aforementioned results. The author predicts that the most important item in the agenda will turn out to be prenatal care, so that a clinical examination can be made and admission to the hospital arranged whenever it is necessary.

This, of course, is not a new observation and many authors over the years have commented on the intrinsic value of prenatal care itself.

—*Thomas W. McElin.*

Rupture of Uterus During Pregnancy. RAYMOND I. MATHEWS. *Obst. Gyn.*, 1961, 17: 551.

A REVIEW of 111 cases of uterine rupture during pregnancy, treated during the past 36 years at the Los Angeles County General Hospital, California, illustrates the changing incidence and prognosis of this serious obstetric complication.

If the early and recent periods are compared, it is seen that the incidence of rupture is reduced by 70 per cent. Much of this reduction is due to a lowering in the number of traumatic deliveries which formerly accounted for almost 50 per cent of the ruptures but now account for only 20 per cent. Ruptures of section scars are less than half that of the earlier period despite the increasing use of abdominal delivery. Rupture resulting from miscellaneous causes has also decreased by about 50 per cent. Under miscellaneous causes the author groups a number of factors, the majority of which suggest previous uterine damage, such as dilatation and curettage, obstructed labor, or overstimulation with oxytocics.

The effectiveness of currently available supportive measures is demonstrated by a comparison of maternal mortality rates, which have fallen from 63 to 6 per cent. However, the fetal risk has not shown corresponding improvement nor altered impressively, being 69 and 55 per cent, respectively.

It is obvious that prevention of rupture is of the utmost importance. This can better be accomplished by (1) close evaluation of the optimum time for repeat section, (2) avoidance of difficult vaginal deliveries, and (3) a careful obstetric history to alert one to the factors that contribute to the group of miscellaneous ruptures. —*Lester T. Hibbard.*

Spontaneous Premature Rupture of the Fetal Membranes. Leslie David Ekvall, William Gleeson Wixted, and Isadore Dyer. *Am. J. Obst. Gyn.*, 1961, 81:848.

The authors report on spontaneous premature rupture of the fetal membranes from the Tulane Obstetrical Unit at the Charity Hospital of Louisiana. An interesting historical review of the literature is presented. They evaluate 363 pregnancies with this complication observed from 1955 to 1959, and discuss the associated maternal and fetal complications. The criterion for their case selection was in accord with the present definition of spontaneous premature rupture of the membranes—any rupture of the fetal membranes prior to the onset of labor without regard to the period of gestation. Their patients emerged from the lowest socioeconomic group. Approximately 85 per cent of the patients were Negroes. Rupture of the membranes was found to occur as early as the fifteenth week of gestation. Four cases were recorded prior to 20 weeks and 207 cases from 36 weeks' gestation to term.

In the detection of cases for study, sterile vaginal examination and the nitrazine test were employed. The authors had no comments regarding the causation of this troublesome problem. All pregnancies in which signs of infection developed were promptly terminated. This policy seemed mandatory on the basis of past experience to prevent the overwhelming generalized sepsis so common in this group of patients. The primary factor in fetal survival was, of course, maturity. Thirteen patients were delivered by cesarean section. All patients with rupture of the fetal membranes existing for 24 hours or more were given antibiotics. These drugs were continued for a period of 10 days. Absolute bed rest was continued until there had been no signs of loss of amniotic fluid for a period of 24 hours. The patients were then ambulated and, if no leakage occurred, they were discharged with admonitions to reduce all physical and sexual activity. No maternal deaths occurred in the series. Seventeen stillbirths occurred among the 363 pregnancies.

The presentation of the fetus appeared to influence its survival. There was a 30 per cent fetal mortality sustained in premature breech infants and only 7 per cent mortality in those with vertex presentation. There was prolapse of the cord in only 1 pregnancy with prematurely ruptured membranes. This is contrary to the general belief that prolapse of the umbilical cord is frequent with premature rupture of the fetal membranes.

The authors conclude with the statement that their present management consists of bed rest, the possible use of prophylactic antibiotics, and intelligent observation with the emptying of the uterus whenever intrauterine infection presents itself. Infections were present in 11.8 per cent of the authors' patients. —*Thomas W. McElin.*

Spontaneous Premature Rupture of the Membranes. Melvin W. Breese. *Am. J. Obst. Gyn.*, 1961, 81: 1086.

During a 10 year period at the Emanuel Hospital, Portland, Oregon, a private general hospital, spontaneous premature rupture of the membranes occurred in 2,887 of 44,723 deliveries, an incidence of 6.4 per cent. This study is primarily concerned with the 515 mothers who sustained this complication and delivered premature infants, an incidence of 1.1 per cent.

Three important considerations are pointed up by this study:

1. Prematurity and a latent period of more than 48 hours—time of rupture to onset of labor—significantly increase perinatal mortality. When labor did not commence before 48 hours in the delivery of premature infants of more than 1,500 gm., the fetal loss was 27.7 per cent; when labor did begin within 48 hours, the fetal loss was 12.3 per cent. In terms of weeks of gestation at the time of rupture, two-thirds of the ruptures occurred between 31 and 38 weeks with a perinatal mortality of 20.4 per cent. The outlook for fetuses of less than 1,500 gm. or of less than 31 weeks' gestation is extremely unfavorable.

2. Administration of penicillin and dihydrostreptomycin to patients with evidence of amnionitis and during labor to those whose membranes have been ruptured more than 48 hours before onset of labor has a favorable influence on perinatal mortality.

3. Breech presentation with vaginal delivery in itself significantly increases fetal loss when spontaneous premature rupture of the membranes is sustained and the infant weighs less than 2,500 gm. In this series there were 103 breech presentations with a 51.4 per cent perinatal loss versus 376 vertex vaginal deliveries with a 26.3 per cent perinatal mortality. There were 32 cesarean sections.

Management should therefore include: (a) careful consideration of the advisability of allowing these patients to go more than 48 hours with ruptured membranes before induction or abdominal delivery; (b) improved techniques of delivery of these premature infants when they are in breech presentation; and (c) antimicrobial therapy in all patients with evidence of amnionitis and during labor in all patients whose membranes have been ruptured for more than 48 hours. —*Lawrence I. Bernard.*

Causes of Premature Labor (Sull'eziologia del parto prematuro). F. Santi. *Ann. ostet. gin.*, 1961, 83: 257.

This study was made at the Department of Obstetrics and Gynecology of the University of Milan Medical School, Milan, Italy, during the years 1955 to 1959.

During this period of time, there were 23,002 deliveries at full term whereas premature labor occurred in 2,299 instances, or 9.99 per cent. No significant fluctuations were noted in the various years.

The major causes of premature labor in order of frequency were: premature rupture of the membranes, 32.79 per cent; toxemia of pregnancy, 8.78 per cent; multiple pregnancy, 6.56 per cent; and intrauterine death of the fetus, 3.65 per cent. Placenta previa, Rh

incompatibility, tuberculosis, cardiopathies, fetal malformations, chronic nephropathies, abruptio placentae, lues, polyhydramnios, and uterine malformations were also responsible.

In 40.30 per cent of the cases no cause for premature labor could be detected. —*Maria Serratto.*

Cesarean Section. JOHN E. WALTERS and ROBERT C. STEPTO. *J. Nat. M. Ass.*, 1961, 53: 271.

THIS 5 YEAR SURVEY is an evaluation of cesarean sections performed at the Provident Hospital, Chicago, Illinois, in 10,341 total deliveries. Of these, 1,940 or 18 per cent were operative deliveries, which includes 280 or 2.6 per cent cesarean sections. In the total delivery group there were 245 perinatal deaths, 15 of which occurred in the cesarean sections, an incidence of 5.3 per cent. Seventy-six of the babies born in the entire delivery group weighed less than 1,000 gm.

Spinal anesthesia was the anesthesia of choice. In this series the indications for cesarean section were: previous sections, 45.7 per cent; cephalopelvic disproportion, 16.7 per cent; placenta previa, 7.8 per cent; abruptio placentae, 5.3 per cent; breech presentation, 4.6 per cent; transverse lie, 3.2 per cent; and toxemia, 2.1 per cent. Other miscellaneous indications were less than 2 per cent.

Of the 15 babies lost in the 280 cesarean sections, hemorrhage from placenta previa or abruptio placentae was the indication for the operation in 9 cases or 60 per cent. The incidence of complications was 12.7 per cent. There were 2 maternal deaths, an incidence of .71 per cent. The mothers were multigravidas in their early thirties. Both were admitted to the hospital at term in early labor with transverse lie confirmed by roentgenography.

It is pointed out in this study that the results bear out that cesarean section (1) is not the solution for all obstetric problems and (2) does not, as many believe, guarantee a live normal baby. The perinatal losses in this study, as in most studies, were mostly due to the complication that was the indication for the cesarean section. Despite the use of the newer antibiotic drugs, the improved safety of the operation itself for abdominal delivery, and the increase in the number of well-trained obstetricians, the maternal morbidity in cesarean sections is about 5 times that in deliveries of all types. In the 280 cesarean sections the fetal salvage rate was 94.7 per cent and the fetal loss rate was 5.3 per cent. The corrected fetal loss rate was 3.9 per cent and the corrected fetal salvage rate was 94.1 per cent.
—*Lawrence I. Bernard.*

Amelioration of the Hypertension of Toxemia by Postpartum Curettage. CHARLES A. HUNTER, JR., WILLIAM F. HOWARD, and CHARLES O. MCCORMICK, JR. *Am. J. Obst. Gyn.*, 1961, 81: 884.

SEVENTY PATIENTS with toxemia of pregnancy were subjected to postpartum uterine curettage in an attempt to ameliorate the hypertension.

Of the 67 patients classified as having acute toxemia, 64 exhibited prompt return of the blood pressure to normotensive levels.

Three patients with essential hypertension without superimposed toxemia of pregnancy showed no blood pressure response to this procedure. —*Alan Rubin.*

LABOR AND COMPLICATIONS

Analgesia During Labor: A Comparison of Pentobarbital, Meperidine, and Morphine. COLIN CAMPBELL, OTTO C. PHILLIPS, and TODD M. FRAZIER. *Obst. Gyn.*, 1961, 17:714.

A CONTROLLED STUDY was made of 212 term patients during labor, 71 of whom were given pentobarbital; 69, meperidine hydrochloride; and 72, morphine, as analgesic drugs.

A total of 95.7 per cent of the meperidine-treated group, 88.7 per cent of the pentobarbital group, and 83.3 per cent of the morphine group were satisfied with the regimen. Conversely, 4.3 per cent of the meperidine group did not indicate that they were satisfied with their medication, as contrasted to 11.3 per cent of the pentobarbital, and 16.7 per cent of the morphine groups.

Of the patients given pentobarbital, 54.3 per cent had total amnesia to the entire course of labor, as compared to 23.2 per cent of the patients given meperidine and 23.6 per cent of those given morphine.

Of the patients given pentobarbital 41 per cent were unmanageable or difficult to manage. This compares to 21 per cent of the patients given meperidine and 14 per cent of the patients given morphine.

The infant results, as judged by a modified Apgar score 1 minute after birth, were similar in the three treatment groups.

Of the three drugs studied the highest incidence of satisfaction occurred in meperidine-treated patients, even though they remained conscious during labor. The pentobarbital group yielded a high incidence of satisfaction with the regimen, because they were unconscious and had total amnesia. The cost of this patient satisfaction was a high incidence of patients who were uncontrollable or difficult to control.
—*John R. Wolff.*

Usefulness of Paracervical Block in Obstetrics. EMERY P. PAGE, MICHAEL L. KAMM, and CLIFFORD C. CHAPPELL. *Am. J. Obst. Gyn.*, 1961, 81: 1094.

THE AUTHORS report their experience with paracervical block in obstetrics since 1956 at the Alta Bates Community Hospital, Berkeley, California. They found it to be a simple, safe, and useful procedure with few complications, when indicated.

Paracervical block is effective only in the relief of first stage labor pains. The chief indication for paracervical block in this series was cervical dystocia, frequently associated with left occipitoposterior positions. Paracervical block not only results in complete relief of pain, but also is usually followed by rapid cervical dilatation and delivery before the block has lost its effectiveness. When there seems to be no progress in dilatation in the absence of cephalopelvic disproportion, it is advantageous to use paracervical block before considering a cesarean section. Paracervical block also is useful in providing relief of pain during curettage to complete a spontaneous abortion. The authors have also used a combined paracervical and pudendal block for the Shirodkar procedure to close the incompetent cervical os during pregnancy.

Lidocaine was used as the anesthetic solution and the sites of injection at 4 and 8 o'clock were selected to

avoid puncturing the uterine vessels. The ideal time to do the block is when the cervix is 4 to 5 cm. dilated with the head at a 0 to plus 2 station. The block becomes more difficult when the cervix is more than 7 cm. dilated or the head closer to the perineum.

Adequate precautions should be taken to avoid the potential maternal complications of (1) puncture of a blood vessel with bleeding and hematoma formation, (2) infection, (3) intravenous administration, and (4) damage to parametrial tissues and its structures. Possible fetal complications are (a) interference with the uterine blood supply with resultant hypoxia and (b) puncturing the fetal presenting part with the needle point.

In the present series of 100 paracervical blocks, there were no maternal complications and in 20 per cent some degree of transient fetal bradycardia was demonstrated. The authors add that they made a survey of 45 members of the Alameda-Contra Costa Gynecological Society, concerning their experience with paracervical block, and the only complication reported was a hematoma in the parametrium after blocking. —*Lawrence I. Bernard.*

Compound Presentation. LOKENATH BHOSE. *J. Obst. Gyn. Brit. Commonwealth*, 1961, 68: 307.

PROLAPSE OF THE UPPER LIMB was the commonest type presented in this series, which consisted of 91 cases of vertex presentation with prolapse of limbs. This abnormal presentation was 3 times more common in multigravidas. Floating head, small baby, and excess amniotic fluid were the main predisposing factors. Contracted pelvis was not common.

The incidence of compound presentation was 1 in 734. Eleven per cent of the patients were admitted in obstructed labor and 30.7 per cent with a dead fetus. Labor was longer than 48 hours in 12.1 per cent. Spontaneous delivery as a compound presentation occurred in 26.3 per cent. In the remainder some form of interference was necessary.

In this latter group spontaneous vaginal delivery was allowed in 33 of 67 cases. Cesarean section is indicated only when complications such as contraction of the pelvis, cord prolapse, or fetal distress exist. However, it may be a safer procedure in certain cases of obstructed labor with a thinned out lower segment even when the fetus is dead. As an alternative treatment to internal version followed by breech extraction cesarean section should get preference especially in primigravidas.

The corrected perinatal mortality was 7.6 per cent. The stillbirth rate was 1.9 per cent and the neonatal death rate was 5.7 per cent.

Craniotomy is indicated in cases of obstruction in which the fetus is dead, provided the vaginal delivery is not likely to be difficult. In cases of doubt abdominal delivery is often preferable. The only maternal death of this series occurred after craniotomy and could have been avoided by a cesarean section.

—*Harry Fields.*

Dysfunctional Labor. EMANUEL A. FRIEDMAN and MARLENE R. SACHTLEBEN. *Obst. Gyn.*, 1961, 17: 566.

AS THE AUTHORS have pointed out in previous publications, the progress of labor can be measured by plotting the rate of cervical dilatation against time. The resulting curve will show a point of upswing which divides the latent from the active phase of the first step of labor. Furthermore, it is possible to recognize abnormal labor by observing the rate of cervical dilatation during the active phase. Normally, this rate exceeds 1.2 cm. per hour, and any lesser figure is evidence of a type of dysfunctional labor which has been called "protracted active phase dilatation."

Protracted active phase dilatation is a clinically important entity. At the Sloane Hospital for Women, New York, it was encountered in 2.9 per cent of 28,750 viable deliveries. Two-thirds of the cases were combined with a supervening secondary arrest and one-third were of a more or less "pure" variety.

If the latter group are considered alone, several observations can be made. First, it may not be recognized unless the rate of cervical dilatation is actually plotted against time. Otherwise, it may be confused with a prolonged latent phase of labor, which has an entirely different clinical significance. Once recognized, proper management is essential for an optimal result.

One should look for cephalopelvic disproportion, malposition, premature rupture of the membranes and amnionitis, and excessive early sedation—all of which are commonly associated with this condition. Next, it must be appreciated that the slow rate of dilatation is an intrinsic feature which cannot be modified by efforts at stimulation. Therefore, such measures as amniotomy or oxytocics are ineffective and sometimes even harmful. Because labor is long and harassing, supportive measures are in order. Attention should be given to nutrition, fluids, electrolytes, rest, antibiotics, and encouragement.

Finally, great patience must be exercised in selecting the time of delivery. Past experience suggests that the trauma of complicated operative delivery might largely be avoided by allowing the patient more time to complete the second stage of labor. It also suggests that the high fetal mortality associated with protracted active phase dilatation is due more to premature and forceful delivery than to leisurely labor. The laissez-faire policy of the ultraconservative obstetrician is in order. —*Lester T. Hibbard.*

Effect of Chlorpromazine and of Promazine on the Progress of Labor (L'effet de la chlorpromazine et de la promazine sur l'accouchement). F. DE SENARCLENS. *Gynaecologia*, Basel, 1961, 151: 165.

CHLORPROMAZINE was administered by various routes to 91 patients in the course of labor; more recently, promazine, prazine, has been given under much the same conditions to 83 patients in labor. Prazine has the same chemical composition, without the chlorine radical, as chlorpromazine.

At present, the relaxant and quieting effect of prazine is enhanced by the administration of merperidine and, where there is a delay in the progress of the labor, an oxytocic, syntocinon; in 1 case, pitocin was added.

In all of these 174 patients, approximately a third were prepared psychosomatically by the method of Lamaze, another third by the method of Reed, and

the remaining third were not so prepared. In 37 of these patients the membranes were artificially ruptured.

Of the 83 patients treated with prazine, the subsequent labor was terminated spontaneously in 72; the forceps was used in 10, and there was 1 breech delivery. There were 40 primiparas and 43 multiparas; in the primiparas the average duration of labor after the treatment was 30 minutes and in the multiparas it was 10 minutes; for the primiparas the total duration of labor was 6 hours, for the multiparas it was 2 hours and 40 minutes. No increased maternal or fetal disease was noted.

As compared with the chlorpromazine treatments, those carried out with the prazine and merperidine therapy have seemed to shorten the period of labor, particularly the periods of expulsion of the fetus and of the delivery of the placenta, with a less marked association of drowsiness on the part of the patient.

Most important, however, in the administration of the prazine, 25 mgm. intramuscularly, and the merperidine, 75 mgm. intramuscularly, when given during the first two-thirds of the period of cervical dilatation, has been the more evident development of a more relaxed and co-operative attitude of the parturient woman, and this tendency to greater co-operation occurred in all 3 groups, in those undergoing psychosomatic preparation and those not so prepared.

On the whole, the author has the impression that the prazine and merperidine treatment represents a distinctly valuable acquisition on the part of the obstetrician. —*John W. Brennan.*

NEWBORN

Umbilical Artery Aplasia. WILLIAM A. LITTLE. *Obst. Gyn.*, 1961, 17:695.

UNTIL RECENTLY, absence of one umbilical artery was regarded as a medical curiosity. Interest in aplasia of the umbilical artery has been revived in the past decade. A portion of umbilical cord proximal to the fetus was obtained from 2,800 consecutive deliveries. The number of umbilical arteries could be determined by merely observing the cut surface of the cord. At times, compression of the cord was necessary. The exuding blood would demarcate the orifice of the umbilical arteries, facilitating their detection. If the vascular architecture was not easily identified, microscopic studies were obtained. All examples of umbilical artery aplasia were confirmed by histologic examination.

There were 21 instances of aplasia of an umbilical artery in 2,800 consecutive deliveries. The incidence of this lesion was 1 in 133, or 0.75 per cent. Since the examined portions of the cords were proximal to the fetal umbilicus, this incidence was thought to be a close estimate of the true occurrence of this lesion.

Six of the 21 infants, 29 per cent, with umbilical artery aplasia died; there were 4 neonatal deaths, 1 antepartum stillbirth, and 1 intrapartum stillbirth. The 4 autopsy cases included 2 infants with multiple abnormalities, mainly cardiac, respiratory, and intestinal in location. One infant was hydrocephalic. The other was apparently premature, the product of a prediabetic pregnancy. The sole congenital malformation was an absent left umbilical artery.

Three of the 19 liveborn infants had fetal bradycardia and meconiorrhea during labor and 3 had Apgar scores of less than 5. Eight of the living infants had physical findings compatible with congenital abnormalities. Two of these had congenital heart disease. Therefore, the incidence of recognized abnormalities in all infants was 48 per cent.

—*John R. Wolff.*

Staphylococcal Infection of the Newborn in Hospital and in Domiciliary Practice. T. F. ELIAS-JONES, I. GORDON, and L. WHITTAKER. *Lancet*, Lond., 1961, 1: 571.

INCREASING OUTBREAKS of serious staphylococcal infection among the newborn infants have been noted in recent years. Some have been so severe that whole hospitals have had to close temporarily, and less dramatic outbreaks are numerous. In hospitals remaining free from major outbreaks, diligent search will reveal cases of minor sepsis due to staphylococci. Less is known of this type of infection in infants born at home, and the present study is a comparison of this hazard in hospitals and in domiciliary practice.

During the period July 1957 to June 1958, bacteriologic studies were conducted in the Borough of Ilford, England, pop. 180,000. In the survey 1,551 infants were visited, representing 70.8 per cent of the "available infant population." Eleven hundred and twenty-nine infants born in hospitals and 414 born at home were examined for evidence of neonatal staphylococcal sepsis. The incidence in the hospital group, 13.6 per cent, was significantly higher than that in the domiciliary group, 4.8 per cent. Sepsis was significantly more prevalent in male infants. Social conditions, seasonal fluctuations, or antecedent obstetric complications did not affect the infection rate. Infections were mainly minor ones: eye, skin, and umbilical infections predominating in the order given. Pathogenic staphylococci were isolated from 77.5 per cent of the infants with clinical infections; 50 per cent of healthy control infants were also found to be staphylococcal carriers. Of the antibiotic resistant strains found, 90 per cent were isolated from infants born in the hospital. —*Wayne F. Cameron.*

SURGERY OF THE MALE REPRODUCTIVE SYSTEM

PROSTATE AND SEMINAL VESICLES

Prostatic Lithiasis Considered as a Carcinogenic Factor (La lithiase prostatique peut-elle être considérée comme un facteur cancérogène). HARRY IOACHIM. *Urologia*, Treviso, 1961, 28: 1.

IN MORE THAN 1,000 histologic examinations of prostates removed in the surgical clinic of the Hospital Panduri at Bucharest, Roumania, the author has noted the extensive concomitance of prostatic cancer and prostatic stone and believes that this association can hardly be one of pure hazard. It would seem that prostatic lithiasis is a causative factor in the evolution of prostatic cancer or that prostatic cancer is a causative factor in the production of prostatic lithiasis. Cancer was diagnosed histologically in 160 of these 1,000 prostates, and in 63.75 per cent of these lithiasis was associated, whereas in the noncancerous cases, the benign adenoma was associated with lithiasis in only 12.5 per cent of instances.

The author believes that the prostatic calculosis, by a long-continued irritative effect of chemical composition of the stone and stasis of secretions and atrophic pressure effect on a prostatic epithelial tissue already predisposed by hormone disturbances of the presenile age, is the initial causative factor resulting in the evident statistical preponderance of neoplastic development in the stonebearing prostate.

—John W. Brennan.

Considerations with Reference to a Technique of Prostatectomy (Sur une technique de prostatectomie). JOAO COSTA and PEDRO RUELA. *J. urol. méd.*, Par., 1960, 66: 784.

THE TECHNIQUE of the authors consists of a transvesical enucleation of the prostatic adenoma by the method of Freyer. The work is carried out by preference under spinal anesthesia with, on occasion, the addition of a light general anesthesia. The prostatic bed is first packed with gauze; then, when everything is in readiness, the packing is withdrawn, a resectoscope of Nesbit is introduced through the urethra into the operative field and, under copious inundation of the field with sterile water, the bleeding points are electrocoagulated under direct vision through the resectoscope, the bladder and abdominal incisions being meanwhile closed, leaving a drain in the space of Retzius.

The technique used permits great rapidity of procedure, so that the operation is always completed within a period of 50 minutes, the average operative time being 45 minutes. This rapidity forestalls any considerable loss of blood, and the frequently aged and ailing patient is spared the dilatoriness of more complicated procedures that favor shock.

In this material there occurred only 3 deaths, 2 from pulmonary emboli, on the second and the sixth postoperative day, and 1 instance of vascular cerebral accident. The patients were regularly gotten up and about by the forty-eighth to the seventy-second hours; they were then regularly controlled for several months, at least until the time when their urinary samples were completely free of pus. During these periods of observation there has not been a single instance of postoperative urinary incontinence. This result is in part ascribed to the fact that the bleeding points which are located in the region of the distal stump of the urethra are but sparingly coagulated, the hemostasis being largely entrusted to the Foley catheter. There have been no instances of pyelonephritis or of infection at a distance.

The authors concede that the method requires great skill and long practice but do not think that this negates the general value of the procedure.

—John W. Brennan.

SCROTUM AND TESTES

Correlation Between Testicular Biopsy and Sperm Count. RODNEY A. MANNION and THOMAS L. C. COTTRELL. *J. Urol.*, Balt., 1961, 85: 953.

BECAUSE OF THE DIFFICULTY in the microscopic interpretation of testicular biopsy tissue, the authors have attempted to correlate the clinical findings and the microscopic picture using a modification of Nelson's classification. The slides were interpreted as showing evidence of either primary spermatogenic arrest, secondary spermatogenic arrest, or complete spermatogenic arrest. In addition they were also evaluated by interpretation of the words "scattered" or "generalized." In primary spermatogenic arrest spermatogenesis had ceased at the primary spermatocyte level but germinal epithelium was present. In secondary spermatogenic arrest, spermatids were not seen, and the entire slide was occupied with primary spermatocytes. "Complete" refers to generalized spermatogenic arrest at the germinal cell or embryonic level. No instance of scattered arrest at the germinal cell level was seen.

More than 40 per cent of the patients had no anatomic abnormality on testicular biopsy. This result no doubt is due to the fact that the patients were selected at random, and were not necessarily those who were known to be azoospermic or oligospermic. One of the most common causes leading to decreased fertility in the presence of normal microscopic findings as evidenced by testicular biopsy is the so-called disorganization seen in the slides. Of 42 patients with normal spermatogenesis, disorganization was found in 26. The 61.9 per cent incidence of disorganization is one of the common causes leading to decreased fertility in the presence of normal microscopic findings in testicular biopsy. *—Peter L. Scardino.*

Varicocele: A Treatable Cause of Subfertility. L. STUART SCOTT. *Brit. M. J.*, 1961, 1: 788.

THE VALUE of varicocelectomy in the treatment of subfertility is discussed. The exact mechanism which produces improvement is not yet clearly understood. The author speculates that there may be a reversible

type of reflex alteration in the caliber of nutritional vessels because in the presence of varicocele, which is generally unilateral, testicular biopsies have shown bilateral tubular changes.

Clinical observations have shown subfertility in 66 per cent of the patients with varicocele and in only 39 per cent of men with no varicocele. Varicocele ligation and division at the deep inguinal ring performed on 108 men with left-sided varicoceles have resulted in a high percentage of return to acceptable fertility.

To overcome the possibility of error due to normal fluctuations in sperm count and motility in assessing the success of the procedure, seminal findings were "ranked" from 1 to 5, with the rank of 1 indicating the highest count and best motility. A No. 5 rank was the least satisfactory. Prior to operation all patients were subfertile. Within 6 months of ligation among those followed up, 67 patients, 83.7 per cent, were judged to be fertile. Eight patients, 10 per cent, had higher seminal rankings but not to fertile levels. The seminal rankings of 4 patients were unchanged and 1 had a lower rank than before operation.

Observations indicated that there was a direct relationship between the degree of subfertility and the size of the varicoceles. Tables are presented which indicate specific improvements in preoperative and postoperative sperm counts and motility. The details of seminal changes in 23 men whose wives became pregnant after varicocele operation are tabulated. This result represented a 29 per cent pregnancy rate achievement within a few months of operation.

Careful selection of cases for this elective operation is necessary with the principal contraindications being previous disease of the opposite testis, i.e., mumps, orchitis, or maldescent, and a sterile wife.

—*Allan K. Swersie.*

SURGERY OF THE GENITOURINARY TRACT

KIDNEYS AND URETERS

Thoracic Renal Ectopia (Ueber die thorakale Nierendystopie). H. TOOLE, P. CHRYSOSPATHIS, and D. PAPADIMITRIOU. *Zschr. Urol.*, 1961, 54:1.

AN ECTOPIC KIDNEY which is located in the chest is a rare phenomenon. The entire literature does not contain 50 cases. The accidental finding of an ectopic kidney in the right half of the chest of a 15 year old boy is reported, and the literature on the subject of thoracic renal ectopia is reviewed. In the authors' case a normally functioning kidney was found. In some instances the renal ectopia is associated with defects of the diaphragm, so that other abdominal organs are also found in the chest. In most instances of thoracic renal ectopia, the kidney was found to be in good condition.

No particular treatment is indicated if the diaphragm is intact and the kidney, except for its unusual location, is normal. —*S. Richard Muellner.*

Wilms Tumor: Epidemiological Experience. JAMES F. GLENN and RICHARD C. RHAME. *J. Urol.*, Balt., 1961, 85: 911.

FROM THE TUMOR REGISTRY follow-up records of the Department of Health of Connecticut have been obtained epidemiologic data with respect to Wilms's tumor. Between 1935 and 1960, 86 cases of this tumor were reported in which the information available included adequate pathologic diagnosis, signs, symptoms, important laboratory data, roentgenologic studies of the abdomen, and methods of treatment.

Wilms's tumor occurs approximately at the rate of three and one-half new cases per year in the state of Connecticut. The most common method of detection was that of an abdominal mass found by the family physician or pediatrician, and the most commonly used method of treatment was nephrectomy with postoperative irradiation. Approximately one-half of the patients so treated survived 2 years and less than one-fourth survived 5 years. This is one of the first community studies of a malignant disease compiled in such a fashion, and it should prove of interest to both public health officials and urologists.

—*Peter L. Scardino.*

Primary Tumors of the Renal Pelvis and of the Ureter (Tumeurs primitives du bassinet et de l'uretère). M. DOSSOGNE and J. CASTIAU. *Acta urol. belg.*, 1961, 29:63.

SIX CASES of primitive tumor of the renal pelvis and of the ureter are reported, with survival of patients for periods of 3 to 5 years. A 56 year old subject with a papillary epithelioma of the renal pelvis and a papilloma of the bladder was operated on by the author's method of total nephroureterectomy and partial excision of the urinary bladder. He is alive and well after 5 years. The second patient, a 34 year old, had a papilloma of the renal pelvis without visible involvement of the ureter. The third was a 70 year old patient with an apparently benign tumor of the pelvic portion of the ureter. Removal of the kidney and all but 5 cm. of the pelvic ureter was carried out. Four years later metastatic involvement of the inguinal lymph glands of that side appeared. The fourth patient was a 38 year old subjected to a total nephroureterectomy associated with a partial resection of the urinary bladder; the ureteral tumor proved histologically to be a benign neoplasm. The fifth patient was a 54 year old male with a huge papilloma of the bladder concealing the left ureteral meatus. The bladder tumor was removed by a total nephroureterectomy with partial resection of the bladder. The patient has since been well and a cystoscopy carried out 3 years later demonstrated a perfectly normal bladder. The sixth patient was a 49 year old subject who was subjected to a total nephroureterectomy with partial resection of the bladder for a papilloma filling the whole of the right ureter and extending through the meatus to involve the contiguous bladder mucosa. Three years later the patient was perfectly well and cystoscopy disclosed a normal bladder.

The authors' service has given up the attempt to determine preoperatively the degree of malignancy of these tumors, the custom being to perform a nephroureterectomy with partial resection of the bladder for all tumors of the pelvis and lumbar portion of the ureter. In the tumors limited to the pelvic portion of the ureter, the custom has been to perform a segmental ureterectomy with partial resection of the bladder and immediate re-establishment of the ureteral continuity by means of a Boari type of plastic ureterovesical anastomosis. —*John W. Brennan.*

Renal Pelvic Pressure Levels in Management of Nephrostomy. MYRON P. WALZAK, JR., and ALBERT J. PAQUIN, JR. *J. Urol.*, Balt., 1961, 85:697.

THE SIMPLE METHOD of studying renal pelvic pressures is presented, wherein an ordinary laboratory buret is used as the water manometer which is attached to the nephrostomy tube at the patient's bedside. A centimeter scale beside the buret facilitates pressure readings and allows adjustment of the manometer to the 0 point, which represents kidney level at the start of each test. The patient is kept supine in bed during a 12 to 24 hour period of the study. Hourly pressure readings are recorded along with notes on temperature, position, and activity of the patient. The test is discontinued in the event of flank pain, temperature elevation over 39 degrees C., or 4 consecutive pressures of 25 cm. of water or greater with the patient quiet and supine.

Usually 2 hours are required before sufficient pressure is reached for the urine to flow down the ureter. The average pressure calculated, the only values excluded are those of the first 2 hours and artifacts clearly associated with altered position or increased activity. In this report, 48 upper urinary tracts were evaluated. When the upper tract was severely obstructed all renal pelvic pressures were

above 20 cm. of water and 91 per cent of these patients required further operative correction before the nephrostomy tube could be removed. When the upper tract was unobstructed, 93 per cent of the manometric results were at or below 15 cm. of water. In instances of partial obstruction, 70 per cent were between 15 and 20 cm. of water.

Manometric testing provides objective prognostication as to what can be expected if the nephrostomy tube is removed at that moment. It is not intended to exclude or replace other indications of upper tract patency. In at least 90 per cent of the usual circumstances the surgeon can expect inadequate emptying and continued renal back pressure if intrapelvic pressures are above 20 cm. of water when the nephrostomy drainage is discontinued. If the pressure in the renal pelvis is below 15 cm. of water, adequate drainage occurs in at least 90 per cent of cases. Borderlines between 15 and 20 cm. indicate partial obstruction which spontaneously progresses or regresses with time. These studies are usually performed 2 or 3 weeks after corrective operation for upper tract obstructions.

If pressure readings indicate persistent, partial, or high grade obstruction, nephrostomy drainage is continued for an additional 4 to 6 weeks before more manometric studies are obtained. Frequently, it has been observed that continued drainage results in a return of pelvic pressure to normal levels.

—*Robert O. Beadles.*

Mannitol Infusion. KEVIN G. BARRY, ARTHUR COHEN, JAMES P. KNOCHEL, THOMAS J. WHELAN, JR., and Others. *N. England J. M.*, 1961, 264:967.

THIS ARTICLE reports the results of renal function studies in 14 patients undergoing resection of an abdominal aortic aneurysm. The studies were planned to evaluate the role of mannitol infusion in preventing the oliguria or anuria which has been known in a number of instances to follow cross-clamping of the abdominal aorta.

The mannitol was infused as a 20 per cent solution at a rate of 5.5 ml. per minute during operation until free aortic blood flow was established. The patients received a minimum of 237 gm. of mannitol during operation. If the postoperative urine flow fell below 60 ml. per hour for 2 consecutive hours a booster dose of 12.5 gm. of mannitol, 1 ampule, was given intravenously during a 3 minute interval. Mannitol 1 or 2 ampules were added to each intravenous infusion bottle as needed during the first 4 postoperative days to maintain the urine volume at 60 to 120 ml. per hour.

Five patients served as controls and 5 received the mannitol as described. The other 4 had complications which necessitated changes in the protocol. There was a statistically significant difference in the flow rates between the 2 groups. During aortic clamping the highest flow rate in the control group was 0.3 ml./minute while the lowest flow rate in a treated patient was 1.2 ml./minute. The authors conclude that mannitol infusion is capable of preventing or interrupting acute functional renal failure and its progression to acute organic renal failure.

—*John H. Davis.*

Dangers of Extracorporeal Dialysis (Nil nocere! Fehler und Gefahren bei der extrakorporalen Dialyse, sog. kuenstlichen Niere). WOLF-EBERHARD GOLDHAHN. *Münch. med. Wschr.*, 1961, 103: 740.

DANGERS INHERENT in the use of the artificial kidney have largely been nullified by improved equipment and procedures since extracorporeal dialysis was first successfully performed in 1943. The only significant remaining danger is the necessity for preventing coagulation of blood during dialysis. Infection, leakage of dialyzing fluid into the patient's circulation, pump failure, thrombosis and embolism, air embolism, fluid loss, and electrolyte shifts can all be avoided. Modern laboratory methods prevent incompatible blood from being used to prime the artificial kidney. Hormones and vitamins which are lost in the dialysate can be replaced. Modern equipment is constructed to minimize the hemolysis, which used to be troublesome. Careful regulation of blood flow to and from the artificial kidney, and continuous monitoring of the patient's weight during dialysis help to avoid overloading the patient's circulatory system.

Despite the use of siliconized tubes, heparin must still be used during dialysis. Normally, heparin is partly depolymerized by heparinase in the liver and kidney, and excreted as uroheparin in the urine. Studies with labeled heparin indicate that a patient with normal kidneys excretes about 66 per cent of an administered dose in 24 hours. Patients with chronic nephritis may excrete 3 per cent or less during that period of time. Hemorrhagic diatheses in patients with renal disease are well known clinically. Uremic patients have a disturbed coagulation mechanism. In addition, their capillary permeability may be increased by circulating heparin, trypsin, acetylcholine, or histamine; by deficits of vitamin C and calcium; and by shock. The uremic patient's bleeding tendency and the results of laboratory determinations on his blood need not be parallel. The duration of uremia has much to do with the severity of hemorrhagic tendencies. Heparin not only aggravates the existing bleeding tendencies, but it also causes allergic or anaphylactic reactions in 5 to 16 per cent of patients.

Despite all that, a bleeding tendency is not a contraindication to extracorporeal dialysis. The artificial kidney is not used prophylactically, but only for vital indications. Dialysis is expected to help the patient correct the causes of his bleeding. Patients with acute anuria should be admitted to competent facilities as early as possible, so that complications from bleeding can be prevented.

—*Elmer V. Dahl.*

The Prone Position in Intravenous Urography for Study of the Upper Urinary Tract. MILTON ELKIN. *Radiology*, 1961, 76:961.

IMPROVED intravenous urographic technique—better contrast medium, abdominal compression, Trendelenburg's position, and more meticulous patient preparation—has decreased the need for retrograde pyelography. There still remains room for improvement in complete demonstration of the ureters. Since the lower pole of the kidney, the ureteropelvic junction, and the ureter lie anterior to the upper pole, the possibility of improving demonstration by use of the prone position was investigated. In most cases of

undilated and unobstructed ureters the results were disappointing, apparently because normal pelvic and ureteric peristaltic activity rather than gravity carries the opacified well-mixed urine toward the bladder. However, in the dilated ureter, the prone study was helpful in demonstration of the lower infundibulum, pelvis, and ureter. —*Lois Cowan Collins.*

Silicone Flotation: A More Accurate Method for the Isolation of Exfoliated Malignant Cells of Carcinoma in the Urinary Tract. LOWRAIN E. MCCREA. *J. Urol.*, Balt., 1961, 85:1006.

DIAGNOSTIC ACCURACY of exfoliative cytology in the early detection of malignant disease is a definite aid in urologic practice. By the use of the simplified method of silicone flotation of the urine specimens, the cells collected for cytologic study are free of the accumulated debris usually observed, thereby permitting a clear microscopic picture. The method was used by Seal in 1959 for the isolation of free floating cancer cells from the blood. Silicone flotation is feasible because of the difference in specific gravity of the various cells and crystals found in the urine. Red blood cells have a specific gravity of 1.092 to 1.097, leukocytes have a specific gravity of 1.075 or less, and the specific gravity of cancer cells was considered in this study to be 1.056, whereas that of the heavy crystals of urinary sediment varies from 1.715 to 2.306.

Cancer cells rapidly disintegrate in acid urine and the addition of an equal volume of 95 per cent ethyl alcohol to the urine helps cancer cell preservation. Freshly voided or catheterized specimens are used. In those individuals who have received roentgen therapy to the bladder area, cytologic examinations are of little value because there is excessive cellular degeneration. Polyvinyl-pyrrolidone is added to the specimen; it has the ability to decrease the tendency of agglutination between the cancer cells and other cellular elements, thereby permitting each cell to sink or float according to its specific gravity. Silicone fluid with a specific gravity of 1.040 is added, centrifugation is performed, and the bolus of cancer and other cellular elements will remain at the bottom of the tube. The heavier cancer cells will have been forced through the silicone barrier while the lighter urine crystals, debris, and mucus remain suspended in the supernatant fluid. The author did not attempt to calculate the percentage ratio between the cytologic smear and the biopsy because of the limited number of cases observed. —*David Rosenbloom.*

The Frequency and Significance of Infection of the Urinary Tract in Trichomoniasis in Women (Zur Haeufigkeit und Bedeutung der Harnwegsbeteiligung bei der urogenitalen Trichomoniasis der Frau, besonders in chronischen, vorbehandelten Faellen). H. BAUER. *Zschr. Urol.*, 1961, 54:67.

THAT TRICHOMONAS VAGINALIS may infect the urethra and Skene's glands has been known for a long time. The bladder can be secondarily infected by trichomonads, but this happens very rarely.

In a series of prostitutes trichomonads were found in the urethra and in the vagina in 68 per cent, in the urethra alone in 8 per cent, and in the vagina alone in 24 per cent. On the other hand, in a group of trichomonad-infected patients seen in routine gynecologic practice, the vagina was infected in 100 per cent of the cases, the urethra in 8 per cent, the cervix in 64 per cent, and Skene's ducts in 95 per cent.

To obtain the evidence that the urethra and Skene's glands are infected by trichomonads, the vulva and the meatus are cleansed and the urethra is firmly massaged through the anterior vaginal wall. A drop of the secretion obtained is examined by means of vital staining, or in the hanging drop, or it may be mixed with warm normal saline and examined at once under the microscope. Trichomonads in the urethra are apt to have a more rounded form and are not very mobile. A urine specimen obtained by catheterization is inadequate for the search of trichomonads in the bladder because trichomonads present in the urethra can be carried by the catheter into the bladder and give an erroneous impression that a trichomonal infection of the bladder exists.

In the treatment of these infections, the author used a preparation called "flagyl," known also as "Bayer 5360." —*S. Richard Muellner.*

Chronic Infection of the Urinary Tract Among Patients with Spinal Cord Injury. A. ESTIN COMARR. *J. Urol.*, Balt., 1961, 85:983.

IN PATIENTS with spinal cord damage, one of the most frequent causes of death—renal disease—can usually be traced to infection; this in turn may or may not be directly connected with the use of catheters, which are unavoidable in most instances in the initial stage of treatment. Ultimately, renal dysfunction results and may be manifested as chronic and/or acutely recurrent pyelonephritis, hydronephrosis or pyonephrosis, or amyloidosis. Any of these conditions can be associated with renal hypertensive disease. In more than 14 years, the total mortality in a series of 1,600 patients at the Veterans Administration Spinal Cord Injury Center in Long Beach, California was 11.5 per cent, and mortality in this series from renal insufficiency was 27 per cent.

Every patient with spinal cord trauma is a potential candidate for genitourinary tract complications. More than 90 per cent of the patients in the series had disease of the urinary tract. Bacteriuria develops within 72 hours of injury. With introduction of an indwelling catheter bacteriuria will persist in most cases even after removal of the catheter. The infection arises from reactive urethral inflammation and along the lumen of the catheter. Bacteriuria of itself is relatively harmless when it is not accompanied by severe pyuria. In the initial stage, immediately after injury, mild urinary antiseptics such as mandelic acid and sulfonamides may have a place. The author reserves more potent antibiotic drugs for acute severe exacerbations.

Prophylactic administration of drugs is not as important as the development of local kidney immunity. Most important is the continuous vigilance for complications by periodic examinations; there may be insidious regression of renal function without overt symptoms and signs and in the presence of excellent bladder function.

Although the ultimate management goal is a catheter-free existence in order to reduce catheter complications such as urethritis, penoscrotal urethral diver-

ticula or fistulas, pseudopapillomatosis of the bladder, and vesical calculosis, most workers employ indwelling catheters from the very onset. A noncatheter-bearing well-functioning bladder does not insure against hydronephrosis, reflux, or pyelonephritis. Patients who have an indwelling catheter and are in comparatively good health demonstrate that it is not so much the presence of an indwelling catheter as the development of obstructive lesions in the upper urinary tract that leads to significant renal infection.

The Foley catheter bag produces serious complications, which are corrected by introduction of a plain whistle-tip catheter. The Gibbon polyvinyl catheter is nonirritating and has a narrow total caliber; almost no urethritis accompanies its use.

Suprapubic cystostomy is used only for diversion of the urinary stream for penoscrotal periurethral disease, in rare cases of perineal urethral diverticula, in urethral stricture, in exceptional nursing problems, and occasionally for vesicoureteral reflux and recurrent attacks of pyelonephritis. Catheter introduction requires strict aseptic technique and frequent drainage and catheter tube changes are required to keep down infection. Urethral discharge requires local therapy. Closed systems of bladder irrigation are best. The greatest of care must be taken to avoid ascending infection along the lumen of the tubing.

—David Rosenbloom.

The Use of 1314 TH in Tuberculosis of the Urinary Tract (Le 1314 TH en tuberculose urinaire). TRUC, SCHILLIRO, and DION. *J. urol. méd.*, Par., 1960, 66: 729.

ETHIONIAMIDE or 1314 TH is the thioamide of alpha-ethyl isonicotinic acid which was synthesized in 1956 by D. Libermann, Rist, and Grumbach. This synthetic preparation has been tested by the authors on 25 patients who were suffering from various forms of urinary tuberculosis. These individuals had as a rule undergone treatment with the classical antitubercular preparations, such as streptomycin, PAS, isoniazid, and viomycin, with failure to cure. The most frequent type of drug resistance encountered was that toward isoniazid and the new preparation was used as a rule as a substitute for isoniazid; the other preparations, however, were largely continued in association with the ethioniamide therapy. The usual posologic technique consisted in the daily administration of a suppository containing 1 gm. of ethioniamide. A course of treatment consisted of as much as 40 daily doses.

The clinical manifestations of intolerance included nausea, vomiting, loss of body weight, and headaches. Laboratory procedures at times demonstrated functional disturbances of the liver. There was no appreciable difference in these manifestations, at least qualitatively, as between the oral and the rectal methods of administration; in all these manifestations the phenomena promptly disappeared with interruption of the ethioniamide administration. In some instances, indeed, the gain in weight and other evidence of well-being even surpassed the pretherapeutic level.

On the whole, most improvement from this therapy was shown in the early active lesions of urinary tuberculosis; in this group the results ranged from good to very good in 67 per cent. In the older, more slowly evolving lesions there were obtained in 56 per cent of cases results which may be classified from passable to good. In the graver, destructive lesions no evaluable results were obtained in the cases here studied, cases which are, of course, few in number.

Roentgenologically, 16 of the 25 patients showed an appreciable stabilization of their lesions with a decided tendency toward cicatricial evolution; these patients had active lesions. In 7 patients with older, chronic processes improvement was demonstrated roentgenologically in 2 instances. In the remaining 2, in whom the disease was advanced, aggravation resulting from treatment now leads to the envisaging of a nephrectomy.

The authors believe that ethioniamide has a place in the treatment of tuberculosis of the urinary system and earnestly desire that others will add to the number of cases reported, thus reinforcing the evaluations here presented. *—John W. Brennan.*

Origin, Clinical Experiences, and Treatment of Urinary Obstructions of the Lower Ureter in Childhood. PETER F. BISCHOFF and H. GERHARD BUSCH. *J. Urol.*, Balt., 1961, 85: 739.

PRIMARY and many forms of secondary megaureter are thought to originate because of (1) conflicts between the secretions of the mesonephros and metanephros, which start in the second embryonal month, and (2) peripheral obstructions caused by anomalous obstructive development.

From their clinical experience the authors recommended the following principles of treatment: Removal of urinary obstruction should be accomplished promptly by radical measures. Unrestricted urinary drainage must be secured from the beginning. Their experiences with simple reimplantation of the ureter into the bladder or the pull-through method were not favorable. Shortening of the ureter and utilization of the normal ostium have been proved for the treatment of primary megaureter in infants. In secondary megaureter the vesicoureteral reflux should be corrected at the same session.

Removal of obstructive disturbances of the vesical outlet permitting free emptying of the bladder without residual urine is a basic condition of success and must be secured by constant catheter drainage, instrumental or surgical. The Boari plasty is preferred in patients more than 14 years of age because it is easier and more dependable to secure drainage in serious infections or renal decompensations, and an eventually occurring secondary reflux can be corrected later.

In bladder obstructions which are neurogenic in origin the results are unsatisfactory and the results with "ostioplasty" in vesicoureteral reflux of neurogenic bladder are uncertain. *—Robert O. Beadles.*

Ureteroceles in Infants and Children. AURELIO C. USON, JOHN K. LATTIMER, and MEYER M. MELICOW. *Pediatrics*, 1961, 27: 971.

THE AUTHORS report a series of 44 cases of ureteroceles in children, noting that many of these cases are overlooked or mismanaged. They state that while the complication is rare, 1 in 12,000 pediatric admissions

as noted by Gross and Clatworthy, Campbell encountered this lesion in 1 of every 25 children examined for pyuria and in 1 of about 3,500 autopsies. Gummies and his associates found ureteroceles in approximately 2.7 per cent of all children who were studied urologically.

Intravenous urography helped in evaluating the over-all status of the urinary tract and was decisive in arriving at a correct diagnosis in about 50 per cent of all cases regardless of the size and appearance of the ureterocele. Cystoscopy was employed only when the diagnosis was uncertain.

Small ureteroceles with minimal dilatations of the urinary tract were best managed by cystoscopic slit of the stenotic ureteral orifice. The larger ureteroceles with severe dilatation of the upper urinary tract were treated by complete heminephroureterectomy whenever possible and ureterocelectomy. It has been the authors' policy to treat these children for a long time with wide spectrum antibiotics in order to control more effectively the concomitant urinary tract infection. If the ipsilateral renoureteral unit was not severely damaged there was no need for its removal; it was preserved whenever possible. Ureteroneocystostomies, ureteral meatotomies, or vesical neck plasties were occasionally performed to correct concomitant malformations or complications. Two cases of ectopic ureter opening into the rectum are mentioned.

—*Paul R. Leberman.*

A Classification of Ureteroceles in Children. Aurelio C. Uson. *J. Urol.*, Balt., 1961, 85:732.

A classification of ureteroceles in children based on the degree of upper urinary tract damage and bladder neck obstruction and on the gross characteristics of the ureterocele is presented. Type A has minimal upper urinary tract dilatation, and small ureteroceles and cystoscopic fulguration suffices in this group; type B, severe dilatation of at least one upper urinary tract unit and large ureteroceles; type C, severe dilatation of the upper urinary tract and also evidence of bladder neck obstruction produced by the ureterocele. Types B and C are further divided into grades 1, 2, 3, and 4, depending upon the number of upper urinary tracts dilated.

The author classifies 44 patients with ureteroceles into these 3 categories. In types B and C, excision of the ureterocele and nephroureterectomy of the involved tract yielded the best results. Cystoscopic slit of the ureterocele had to be performed in some cases as a preliminary step or in order to relieve symptoms or decompress the upper tract. This classification can be used as a way of grouping cases consistently, as an aid in selecting the best treatment for each, and as a guide for comparing results of treatment.

—*Robert O. Beadles.*

BLADDER AND URETHRA

Primary Localized Amyloidosis of the Bladder. Raymond C. Kinzel, Edgar G. Harrison, Jr., and David C. Utz. *J. Urol.*, Balt., 1961, 85: 785.

The authors reviewed clinical and pathologic features of 16 cases of primary localized amyloidosis of the urinary bladder reported in the literature and reported 5 additional cases. The disease was found incidentally at necropsy in 2 patients. The remaining 19 were treated surgically for the amyloidosis. The major symptom was painless gross hematuria, and the principal sign a vesical mass often mistaken for a neoplasm.

Biopsy of the bladder, necessary for diagnosis, reveals amyloid deposition usually in the submucosa and muscularis. Inflammation, focal necrosis, ulceration, and poor healing, particularly when amyloid involves blood vessels, may account for the recurrent hematuria.

The authors consider the treatment of choice to be segmental resection of the bladder if feasible; however, they indicate that transurethral electrocoagulation may be effectively employed, as it was in approximately one-third of their new cases. Recurrent hematuria necessitated total cystectomy and bilateral ureterosigmoidostomy in 1 case. Results of treatment were generally excellent.

Clinically manifest amyloidosis of the bladder is apparently a localized form of amyloidosis and not secondary to an occult or systemic disease in the opinion of the authors.

Indication and Results of Partial Cystectomy in Carcinoma of the Bladder (Indikation und Ergebnisse der Blasenteilresektionen beim Harnblasenkarzinom). Karl M. Bauer and Fritz H...sse. *Med. Welt*, 1961, p. 628.

Two surgical procedures are utilized in cancer of the bladder, depending on specific indications: total cystectomy with diversion of the urinary stream and partial cystectomy with or without ureteroneostomy. With the diagnosis of cancer of the bladder established, a number of factors influence surgical management; the size and the location of the tumor, the degree of malignancy, and the depth and penetration of the cancer. According to Jewitt, the penetration of a bladder cancer can be classified as follows: group 1, penetration through the mucosa up to the submucosa; group 2, extension of the growth to the musculature of the bladder; and group 3, extension of the growth through the muscle layers of the bladder.

In group 1, metastases are usually absent. In group 2 and in group 3, only 14 to 26 per cent of the cases are free of metastases.

In the consideration of partial cystectomy the following points are of importance: (1) Bimanual examination must reveal no perivesical infiltration; (2) the tumor should not be much greater than a walnut; (3) it should not be located on the trigone or at the vesical outlet; (4) there must be sufficient bladder wall left to reconstruct a small bladder; and (5) a 2 cm. margin beyond the tumor is necessary for adequate resection in papillary tumors.

Indications for partial cystectomy cannot always be accurately determined preoperatively and the final decision may have to be made at the operating table.

In a series of 17 cases of partial cystectomy for cancer of the bladder, 2 patients died 3 to 6 months postoperatively; 3 patients died between 6 and 12 months; and 1 patient died 1 year after the operation. According to the literature, the 5 year survival after partial cystectomy for bladder carcinoma amounts to

between 21 and 24 per cent. If the muscularis is invaded by tumor, a total cystectomy is apt to give somewhat better statistical results. The advantage of partial cystectomy, when it can be carried out, is the undisturbed renal function, a good functioning bladder, and avoidance of electrolyte disturbance.

—*S. Richard Muellner.*

Cystometry During and Cystography After Transurethral Resection of Bladder Tumor. HENRY BODNER, ALLAN H. HOWARD, JOSEPH H. KAPLAN, and STANLEY C. ROSS. *J. Surg. Res.*, 1961, 1:72.

HAVING OBSERVED extravasation after transurethral resection of bladder tumors and being concerned about the possible dissemination of tumor cells through the bladder wall during such procedures, the authors present studies of intravesical pressure during endoscopic resection and cystography after such resection.

Cystometrograms show a wide variation in intravesical pressure during such procedures, and pressures from 20 to 60 mm. of mercury were recorded. In a series of 140 patients, postoperative cystograms showed perivesical extravasation in approximately 70 per cent. These studies suggest the possibility that the bladder wall barrier may be frequently opened and potential dissemination of tumor may occur. To overcome this, the authors suggest several modifications in technique. First, an attempt should be made to seal off the base of the tumor prior to resection by fulguration of the stalk and base. Second, to avoid dangerous increases in intravesical pressure, a Y tube can be interposed in the irrigating fluid circuit and the surgeon notified when the water level becomes dangerously high. Even more ingenious is the suggestion that a float valve mechanism which will activate an electrical current be incorporated, such that a bell or buzzer will warn the surgeon of an excessive rise in intravesical pressure.

—*Vincent J. O'Conor, Jr.*

A New Procedure for Correction of Urinary Incontinence: Preliminary Report. JOHN L. BERRY. *J. Urol.*, Balt., 1961, 85:771.

URINARY INCONTINENCE after prostatectomy continues to be an infrequent but distressing complication. Of the many methods proposed for the correction of this disabling condition, none has been universally successful. The author presents a new method designed to kink and compress the bulbous urethra by implanting an acrylic prosthesis between the bulbous urethra and the bulbocavernosus muscle. The prosthesis, a broad rectangle, one end of which is bent to present an L, is molded to fit the specific patient, and is fixed into position by sutures placed through holes drilled in the four corners. Placement is effected through a perineal incision exposing the bulbous urethra. A pouch is created beneath the bulbocavernosus muscle, and the fixing sutures are brought laterally through the ischiocavernosus muscles, bringing the prosthesis up against the urogenital diaphragm, and, thereby, compressing the bulbous urethra.

Eleven patients have been subjected to this procedure at the Veterans Administration Hospital, Albany, New York. Four patients each were incontinent after suprapubic prostatectomy and transurethral prostatic resection. Of these 8 patients, 5 obtained complete control. One patient who was incontinent after radical perineal prostatectomy, and 2 patients with neurogenic dysfunction who had had previous transurethral resection were not benefited.

No significant complications were encountered with these 11 patients, and the author states that in case of failure the procedure may be repeated several times without untoward sequelae.

—*Vincent J. O'Conor, Jr.*

Preliminary Report on Modified Vesicourethropexy. LOUIS B. GAKER, KENNETH M. SMITH, and HYMAN HELFMAN. *J. Urol.*, Balt., 1961, 85:781.

SUPRAPUBIC VESICOURETHROPEXY, as described by Marshall-Marchetti and Kranz, has gained widespread acceptance for the correction of stress incontinence; nevertheless, the authors describe a failure occurring 3 months after operation, which apparently resulted from disruption of the sutures placed in the symphysial synchondrosis. In an attempt to overcome this complication, several modifications were devised and are presented. The major change involves drilling fine holes in the symphysis pubis through which the elevating sutures are drawn and secured to the rectus fascia. From 1 to 3 such sutures are placed on either side approximately 1 cm. from the midline. Additional sutures, if necessary, are placed in the perivaginal fascia or anterior bladder wall and similarly brought through the rectus sheath. The other change involves spraying the space of Retzius with a light covering of talc to stimulate postoperative fibrosis and fixation.

Sixteen patients have undergone this procedure, and osteitis pubis was not encountered. Partial retention and recurring cystitis which responded to urethral dilatation developed in 3 patients. All 16 were completely relieved of stress incontinence.

—*Vincent J. O'Conor, Jr.*

SURGERY OF THE MUSCULOSKELETAL SYSTEM

BONES AND JOINTS

The Mineral and Protein Framework of Normal and Pathologic Human Bone as Seen by the Electronic Microscope (La trame mineralo-protidique de l'os humain normal et pathologique vue au microscope "electronique"). R. FONTAINE and A. MEYER. *Bull. Soc. internat. chir.*, 1960, 19: 628.

R. LERICHE made the following statement after investigating posttraumatic osteoporosis, "One sees nothing except the end result, the bone has disappeared." It appears that posttraumatic or, for that matter, any other type of osteoporosis is not necessarily a cellular phenomenon but more so a problem of the tissue itself.

Bone fragments which were removed at the time of operation or taken from fresh cadavers were mounted in n-butyl methacrylate, cut by a Servall-Potter microtome equipped with a diamond and, after some additional steps, were examined under a Siemens electronic microscope. Particular attention was paid to the changes of the mineral and the protein structures.

Three distinct findings were observed: (1) simple demineralization; (2) demineralization with consecutive fibrinoid necrosis; and (3) demineralization with simultaneous fibrinoid necrosis. The term osteolysis would apply to groups 2 and 3 inasmuch as both the mineral and the protein substances disappear simultaneously. Changes in the bones which are caused by general systemic disease such as rickets and Paget's disease show upon examination in the electronic microscope that either changes of group 1 or 2 occur but that occasionally a combination of both of these changes were observed. It is interesting to note that in posttraumatic osteoporosis a combination of both demineralization and osteolysis was observed.

—George I. Reiss.

Suppurative Arthritis of Infancy. G. C. LLOYD-ROBERTS. *J. Bone Surg.*, 1960, 42-B: 706.

IN INFANTS with pyogenic arthritis alarming roentgenologic signs may develop which may give a false impression of the extent of damage to the joint. Attention is drawn to the powers of resistance of the growing ends of bones in suppurative pyogenic arthritis, and it is emphasized that a translucent zone in the roentgenogram does not necessarily mean that this part of the bone, epiphysial cartilage, or plate is destroyed. The final shape of the articulating surfaces is dependent upon the damage caused to the epiphysial cartilage and plate, which cannot be seen in an early roentgenogram. Five clinical signs relating to three roentgenologic signs are described as diagnostic criteria to confirm that cartilage or decalcified bone has survived the infection in the knee joint. Seven case reports are given.

The hip joint presents greater difficulties in diagnosis and more is at stake. It is recommended that the hip joint be manipulated or explored if the roentgenogram and physical signs suggest that destruction of the joint has either caused dislocation or has damaged it so that dislocation is likely to occur in the future. Stability may be restored or a diagnosis of irreparable destruction established. Five case reports are cited.

—David E. Hallstrand.

Treatment of a Septic Joint. ARTURO C. ORTIZ and WALLACE E. MILLER. *South. M. J.*, 1961, 54: 594.

AN ANALYSIS of 34 cases in which septic joint was treated by or under the supervision of members of the orthopedic service of the University of Miami School of Medicine, Miami, Florida is presented. All cases of gonococcic arthritis have been excluded, as were those in which there was evidence of bone changes within 3 weeks of the onset of the infection in the joint and those in which concurrent fractures communicated with the infected joint.

Of the 34 patients in this series 16 were white and 18 were colored. Ten were 2½ years old or less. Twenty-five were males and 9 were females. The knee was involved in 21 cases, the hip joint in 6, and the ankle in 4. There was 1 instance each of disease of the elbow, the sternoclavicular joint, and the shoulder joint. The organism most frequently cultured was Staphylococcus pyogenes var. aureus, which appeared in fluid from 13 joints, and next in frequency were Streptococcus pyogenes and Staphylococcus pyogenes var. albus.

There was no uniform method of treatment for this group of 34 septic joints, although certain trends were apparent. All patients received antibiotic agents systemically and all received some form of local treatment to the joint. Local treatment usually consisted of aspiration of the pus with instillation of the antibiotic agents; this was done in 21 cases. In some instances a polyethylene tube was inserted into the joint for constant gavage of the joint. Incision and drainage were accomplished in 8 cases. The antibiotic agent preferred for local administration was penicillin, and it was used in doses of 500,000 to 1,000,000 units per instillation. Newer antibiotic agents were instilled into the joints in 8 patients, but there seemed to be very little information as to the degree of tolerance or effectiveness of these newer preparations. The most common antibiotic product used for parenteral administration was penicillin, and frequently it was used in combination with chloramphenicol, streptomycin, novobiocin, and tetracycline.

Twenty-seven patients were available for follow-up studies, and among them there were no instances of osteomyelitis, of pathologic dislocation of the hip, or of ankylosis of the involved joint. Residual muscular atrophy and loss of a few degrees of motion were found in several cases.

In the final paragraphs the authors comment on the use of various antibiotic agents, the permeability of the synovial membrane, and the arguments for and against the open treatment of septic arthritis.

—Einer W. Johnson, Jr.

Some Problems in the Diagnosis and Treatment of Acute Osteomyelitis. NIGEL H. HARRIS. *J. Bone Surg.*, 1960, 42-B: 535.

THIS REPORT is based on a detailed analysis of 45 patients with acute osteomyelitis who were admitted to the Orthopedic Department, Fulham Hospital, London, England. Most of the patients showed one of the following features: (1) an acute onset with high fever and obvious toxicity; (2) severe pain at one site in a limb; (3) well localized tenderness and sometimes swelling over the affected part; this is an invaluable early sign and with care can be elicited in most patients. Acute osteomyelitis may resemble poliomyelitis in the early stages.

Delay in starting treatment was closely related to the length of stay in the hospital. Fifty-eight per cent of the patients treated late stayed over 4 months compared with 13 per cent of those treated early. The average length of stay of those who received early treatment was 61 days, and of those who were treated late, 132 days.

The danger of giving antibiotic treatment—usually penicillin—before diagnosis is that an inadequate dose may mask the signs and symptoms of the true condition and perhaps allow penicillin-resistant organisms to develop. The most important consideration in choosing an antibiotic drug is the sensitivity of the infective organism. In 32 patients the responsible organism was cultured, either from the blood or directly from the bone focus, and its resistance to the various drugs was determined. From 12 patients Staphylococcus aureus resistant to penicillin was grown. Seven had been given some penicillin before culture of the organism—1 for 3 weeks and the others for only 5 days or less—so it is probable that most of the organisms were resistant from the beginning. Penicillin is clearly not the drug of choice in the first instance.

The white blood cell count was found to be a most unreliable guide. The erythrocyte sedimentation rate was almost invariably raised during the initial stage of the illness. Of the 13 patients who relapsed, 11 were suitable for analysis; 6 of them showed a persistently raised erythrocyte sedimentation rate whether having antibiotic treatment or not; in the other 5 patients, however, the sedimentation rate returned to normal. It is recommended that the sedimentation rate and neutrophil to lymphocyte ratio be recorded weekly or even twice a week in patients with acute osteomyelitis.

Patients with osteomyelitis given antibiotic treatment within 3 days of onset rarely relapse and they remain in hospital a relatively short time. Early treatment with antibiotics is more important than operation in preventing relapse. The prognosis in those treated by operation compares favorably with those treated without. Tetracycline is the drug of choice if the sensitivity of the infecting organism is not known, and all antibiotic drugs should be given in full dosage for at least a month; they should not be given before admission to the hospital. The provisional diagnosis was anterior poliomyelitis in 17 of 45 patients; acute osteomyelitis was diagnosed in 12 only. The criteria for making an early diagnosis are discussed, including the value and limitation of blood culture.

—*C. Fred Goeringer.*

Spinal-Cord Tumor—A Cause of Progressive Neurological Changes in Children with Scoliosis. PAUL H. CURTISS, JR., and WILLIAM F. COLLINS. *J. Bone Surg.*, 1961, 43-A: 517.

PROGRESSIVE SCOLIOSIS in the presence of a neurologic disorder such as a developmental defect of the nervous system, Friedreich's ataxia, von Recklinghausen's neurofibromatosis, syringomyelia, and poliomyelitis is well known and can be explained on the basis of neurologic deficit and resultant muscle imbalance. Progressive neurologic deficit in a patient with established scoliosis is a more difficult problem and the authors wish to stress the possibility of spinal cord tumor as a coincidental lesion or the cause of both scoliosis and neurologic loss.

Three cases of spinal cord tumor causing progressive neurologic changes in children with scoliosis are presented. In each case a diagnosis of poliomyelitis had been made early in childhood and the later neurologic changes which appeared were attributed to the scoliosis. The importance of following up such cases with periodic examinations to rule out other neurologic diseases is emphasized.

—*David E. Hallstrand.*

Internal Fixation of Fractures Using Homoplastic and Heteroplastic Bone (Erfahrungen bei der Fixierung von Frakturen mit homoioplastischen und heteroplastischen Knochen). W. KÜPPERMANN. *Bull. Soc. internat. chir.*, 1960, 19: 664.

THE AUTHOR USED screws, nails, and plates made of bone for internal fixation of recent and old fractures of bones. The procedure was used in 457 cases including fracture of the clavicle, humerus, forearm, small bones of the hands and fingers, tibia, and small bones of the foot. In fractures of the neck of the femur and the femoral shaft the author recommends the use of metallic appliances. Prior to the insertion of the bone, nails, screws and special instruments are necessary to prepare the holes to receive the inserts of bone. Autogenous bone is successfully used in pseudarthrosis and in cases in which a defect exists between the bone fragments. Homogenous or heterogenous bone is used in open reduction of fresh fractures. Bone preserved in "cialit" solution was used in 76 cases and showed considerable reaction, particularly in cases in which heterogenic bone was used.

Bone preserved by deep freezing was used in 191 operations and proved to be superior to that preserved in "cialit" solution. The best results, however, were obtained with bone prepared by commercial firms that obtained the bone from 1 to 2 year old cows. In addition to its ready availability, very few reactions were observed. Only local osteitis or osteomyelitis was occasionally seen. There were no cases of the severe osteomyelitis so often seen with the use of metallic appliances.

—*George I. Reiss.*

Transplants of Osteogenic Tissue (Après une greffe de tissu squelettique ostéogène, c'est á partir des cellules transplantées que se constitue l'os de nouvelle formation). A. DANIS. *Bull. Soc. internat. chir.*, 1960, 19: 647.

THE AUTHOR makes an attempt to clarify the controversy as to whether transplant of bone induces the formation of bone in the host tissue or whether the

cells of the transplanted bone contribute to the formation of the new bone. Lavander in 1938 placed alcoholic extracts of bone into muscle tissue and induced the formation of bone and cartilage. Two experiments were carried out; in the rat, the new bone usually takes its origin from the transplanted bone.

In 1 case it was shown that in the diffusion chamber of Algire, in which bone marrow is completely separated from the host cells, ossification took place. The transplant of bone marrow, fibrous cartilage, or periosteum changes into small bone. Autogenous bone remains as a transplant, whereas homologous bone transplants usually undergo degeneration.

—*George I. Reiss.*

Osteoporosis in Plasmacytoma (Osteoporose beim Plasmozytom). REINHART KANTHER. *Med. Welt*, 1961, p. 779.

HEISER AND SCHWARTZMAN, in 62 cases of plasmacytoma—multiple myeloma—found that only 13 per cent showed the "classical" roentgenographic picture of punched-out foci of bone destruction; most showed a diffuse osteoporosis, or a mixed diffuse and circumscribed process. The author confirmed the finding in 29 cases at the Berlin Wenckebach Hospital, Germany.

Plasmacytoma is a generalized bone marrow disease, a myelomatous metaplasia. Hyperplastic marrows produce osteoporosis and osteoclasis; hypoplastic marrows result in osteosclerosis. Bone is constantly "moulting," osteoclasts are tearing down and osteoblasts are building up; these cells are indistinguishable morphologically but have opposite functions; they derive from mesenchymal cells in the cortical-medullary interface. In the epiphyses of embryonal bone Tischendorf found large reticulum cells with eccentric basophilic nucleoli-containing nuclei which he considered primitive plasma cells. He also found giant osteoclasts in the peripheral embryonal marrow made up of clusters of these cells.

In plasmacytoma, it is these mesenchymal marrow elements which proliferate in undifferentiated manner, their osteoclastic powers producing osteoporosis. A similar process occurs in the macroglobulinemia of Waldenström, in which there is a paraproteinemia with lymphoid and plasma cell hyperplasia and a diffuse osteoporosis.

Along with mesenchymal destruction, in plasmacytoma, there is a protein degeneration. The organic part of bone consists of cells—osteoblasts, osteocytes, and osteoclasts—collagen fibrils, and cement or ground substance. Inorganic calcium carbonates and phosphates are enmeshed in this cement substance, and nutrients permeate through the lacunae in the system. We no longer consider osteoporosis solely as a mineral defect in bone; it may also result from a protein disturbance. The organic matrix or cement substance is made up of complex proteins and carbohydrates in combination. This ground substance is metabolically active, and in "hunger osteoporosis" and protein deficiencies secondary to liver diseases the cement substance reacts to albumin lack by losing its ability to pick up calcium. In plasmacytoma, there is a paraproteinemia; these paraproteins, according to immunoserologic investigations, are pathologic albumins which cannot be used in albumin metabolism.

These protein deficiencies in plasmacytoma account for the drop in ability to produce antibodies, which Zenneman demonstrated. Specific proteins are also disturbed; Müting showed abnormal amino acids in the hemoglobin of patients with myeloma.

The author refers to many articles on the bone marrow histology of plasmacytoma, and reviews the microscopic changes which he says illustrate well this special form of "myeloma osteoporosis," due to (1) mesenchymal destruction, by the growth of plasmacytoma cells on the endosteal border layer and; (2) loss of organic bone ground substance through protein deficiency resulting from paraprotein formation and disturbances of albumin metabolism.

—*William B. Gallagher.*

Bone Sarcoma Complicating Paget's Disease. STEFAN C. SCHATZKI and H. ROBERT DUDLEY. *Cancer*, 1961, 14: 517.

THE PROGNOSIS in patients with bone sarcoma complicating osteitis deformans is considered very poor. The purpose of the present article is to report 3 apparent cures. This brings to 7 the number of reported cures. One of the present cases had been reported previously. The 3 apparent cures occurred in 20 cases of bone sarcoma arising in Paget's disease at the Massachusetts General Hospital, Boston, from 1925 to 1960.

A 58 year old woman had a midthigh amputation for osteogenic sarcoma of the tibia superimposed on monostotic osteititis deformans of the tibia of many years' duration. Six months later, high thigh amputation was performed for what was thought to be recurrence in the stump, but which proved to be cellular myositis ossificans. Seventeen years later she was alive and without evidence of recurrence.

In a 54 year old man, with diffuse Paget's disease of 30 years' duration, an osteolytic lesion of the midthird of the right humerus developed. The tumor, brachialis muscle, and 6 inches of humerus were excised. A bone graft used to bridge the gap subsequently absorbed. The pathologic diagnosis was fibrosarcoma. He remained without evidence of recurrence until death from heart failure almost 8 years later.

A 55 year old woman had bowing of the tibia from Paget's disease for 20 years. Increased local heat and swelling developed after a minor injury. Roentgenograms showed evident Paget's disease and extensive destruction of the tibia by malignant tumor. Midthigh amputation was performed and she is alive without evidence of recurrence 9 years later. Microscopically the tumor was a fibrosarcoma.

It is suggested that sarcomas arising in monostotic Paget's disease may have a good prognosis, and it is recommended that unicentric sarcomas complicating Paget's disease be treated by extirpative surgery whenever possible. —*Lockert B. Mason.*

Radiotherapy for Osteogenic Sarcoma. ROBERT C. TUDWAY. *J. Bone Surg.*, 1961, 43-B: 61.

BETWEEN 1942 and 1946 9 tumors were treated by doses of 5,500 to 8,000 rads given with the object of permanent cure. Over the same period 51 amputa-

tions were performed for tumors without demonstrable metastases. Sixteen patients, 26 per cent, were alive 3 or more years after treatment. If the 28 patients with advanced disease seen during the same period are added to the failures the rate of survival falls to 17 per cent.

It seems clear that many of the osteogenic sarcomas which may be cured by any method of treatment are locally curable by heavy doses of radiation. However, the radiation needed is heavy enough to risk damage to normal tissues, such as excessive fibrosis and necrosis of bone. This necrosis of bone is less likely with Co^{60} or equivalent radiation, and the use of the cobalt beam or other supervoltage radiation is to be preferred.

If local necrosis of bone does occur the surgeon will need to resect the segment of bone, but may still save the limb. He may think local removal of the tumor a wise precaution in any case, when the reaction to radiation has settled. Amputation is still the treatment of choice for sarcomas of the lower limb.

The cases of 9 patients who were treated for osteogenic sarcoma by elective radical irradiation are reviewed. Five of the 9 patients have survived from 3 to 14 years, but 1 patient has metastases. These results are compared with those from primary amputation. The importance of histologic grading in prognosis is emphasized. It is concluded that radical irradiation should be considered in place of primary amputation for osteogenic sarcoma in the upper limb.

—C. Fred Goeringer.

Supracondylar Fractures of the Humerus: A 12 Year Review with Follow-Up. FRANKLIN V. WADE and JOHN BATDORF. *J. Trauma*, 1961, 1: 269.

THE MANAGEMENT of 145 supracondylar fractures of the humerus over a 12 year period was reviewed to determine the quality of the care given them. It was possible to evaluate 40 per cent of these patients on a personal follow-up basis.

Eighty-five patients were managed with a single manipulation and plaster fixation. Results were good or fair in 87 per cent and poor in 13 per cent. The remaining patients constituted "problem cases." In one group, treatment consisted of multiple manipulations and fixation without traction. The results were uniformly poor. Another group, equally as bad, were managed with olecranon traction. There were 31 cases in this group and only 1 poor result. In another series, traction followed multiple efforts at reduction without any poor results. There was a small number of patients requiring open reduction because of comminution and severe deformities. The result was good or fair in 60 per cent of these and poor in 40 per cent.

It is believed that this review indicates the value of the use of olecranon traction in the management of supracondylar fractures, particularly in those found difficult to reduce with a single effort.

—Donald C. Geist.

Injuries of the Elbow, A 10 Year Review. JULIUS CONN, JR., and PRESTON A. WADE. *J. Trauma*, 1961, 1: 248.

THE COMBINED FRACTURE SERVICE of the New York Hospital, Cornell Medical Center-The Hospital for Special Surgery, New York City treated 414 injuries to the elbow from 1948 to 1958. These injuries accounted for 6.8 per cent of all injuries treated during this period. Forty-five per cent of patients were hospitalized and 24 per cent were subjected to operation.

Forty-six children were treated for supracondylar fractures of the humerus. Results were good, but in 10 per cent of the children anatomic or functional deformities developed after treatment by plaster immobilization. Rotational displacement was difficult to determine at times and contributed to this deformity. It was believed that wide use of skeletal traction in this fracture would have prevented this 10 per cent of deformities. There were 37 supracondylar fractures in adults, 5 of them open fractures. These fractures were treated by closed reduction and plaster immobilization and by skeletal traction through the ulna. The latter method gave the best results. Open reduction and internal fixation was carried out in 2 patients with good results. Infection at the pin site occurred in several patients and was believed to contribute to the poor result in 2. Too early removal of traction also interfered with a good result.

Fractures of the medial epicondyle occurred in 19 children and 8 adults. Results were generally good with closed reduction and immobilization. Open reduction was needed in a few, with equally good results.

There were 18 fractures of the lateral condyle in children and 8 in adults. Results were good in all. Five fractures of the capitellum were treated in children and 4 in adults. Six of these required open reduction. Results were good in all cases.

Eighteen children were treated for fractures of the head or neck of the radius. Only a few needed manipulation and results were good. There were 134 fractures of the head or neck of the radius in adults. If there was no displacement, fractures in this area were treated by immobilization, 93 patients composing this group. Thirty-eight patients required excision of the head of the radius. Results were good in both groups of patients.

Fractures of the olecranon process of the ulna were seen in 18 children and 59 adults. All of those in children were manipulated and immobilized in plaster with good end results. Operative intervention was needed in 37 adults because of displacement and comminution. Open reduction with fixation of the fragments with stainless steel sutures or the insertion of screws was carried out. Results were good in all of these. Thirteen patients required excision of the olecranon, with good results.

Monteggia fractures were treated in 6 adults. Four of these were treated by open reduction of the radial head, dislocation, and fixation of the ulnar fracture with an intermedullary wire. In 2, the radial head was excised. Some loss of motion and function occurred in 2 of the total number.

There were 4 posterolateral dislocations of the elbow in children with good result from closed reduction in all. Twenty-four simple dislocations and 23 fracture dislocations were treated in adults. Good results followed closed reductions in the simple dislocations. Soft tissue calcifications occurred in 4 patients.

—Donald C. Geist.

Tennis Elbow. R. S. GARDEN. *J. Bone Surg.*, 1961, 43-B: 100.

THE VARIOUS CAUSES of tennis elbow are described—local inflammation, muscular or ligamentous strain, bursal irritation, nipping of synovial fringes, tenoperiosteal tears, disturbances of local metabolism, degenerative changes in the orbicular ligament, and cervical root irritation.

It is noted that the only constant feature of the syndrome is the production of pain during extension of the wrist in radial deviation. This motion is effected by the extensors carpi radialis longus and brevis. However, contracture of the extensor brevis especially causes the typical pain.

With these observations in mind and in the belief that contraction of the extensor carpi radialis was the factor principally involved, it was decided to investigate the effect of interrupting the action of this muscle. Accordingly, an open Z-plasty was performed on the tendon just distal to the musculotendinous junction at the wrist and one "catgut holding suture" inserted. The author reports that weakness in radial extension or in the power of the grip has never been a "troublesome feature." Fifty patients were examined after 9 months to 5 years. No patient failed to benefit and most obtained full and lasting relief.

—*Preston J. Burnham.*

The Treatment of Fractures of the Forearm (Le traitement des fractures d'avant-bras au Centre de Traumatologie de 1948 à 1959). H. EVRARD. *Acta orthop. belg.*, 1960, 26:305.

THE AUTHOR has reviewed the results obtained at Montignies-sur-Sambre, Belgium, in 305 cases of fracture of the forearm. This material was made up of 136 fractures of the radius, 83 of the ulna, and 86 fractures of the two bones. Thirty-nine were open fractures; 10 of these were associated with important muscular destruction and, frequently, with lesions of the nerves or the large vessels. All patients were male, the majority between the ages of 20 and 50 years.

Twenty-three of these patients were treated simply by immobilization without a cast; their fractures were all simple, uncomplicated breaks without appreciable displacement of the fragments. The patients treated by immobilization with a plaster cast were examined roentgenologically and when displacement was found the fracture was reduced under general anesthesia. When the break or breaks were high up toward the elbow, a long cast, including the elbow joint, was applied; when the fracture involved the distal portion of the forearm a simple cuff-cast was deemed sufficient. Osteosynthesis was preferred for all fractures with displacement of fragments.

It was found that retarded consolidation could not be precisely determined by roentgenology, so that the author's figures on retarded callus formation were procured from observation at reintervention. In these 305 cases there were 34 reinterventions. Six of these reinterventions were instituted prior to the end of the fourth month and 21 prior to the end of the sixth month. Actually this precocity of reintervention was later found to be erroneous; several times, too early removal of the material of synthesis was the cause of the need for reintervention. For this reason it has been concluded that the material of the osteosynthesis, in the absence of manifest intolerance, should be maintained for at least 6 months and that the breaking of one of the screws is not a sufficient pretext for reintervention.

In the osteosynthetic treatment, best results were obtained with the tibial bone graft; this was solidly applied and fixed with screws in 33 instances. This tibial graft was applied without disturbing the original metallic osteosynthesis and without opening the focus of the lesion.

It was found surprisingly enough that eventually all these cases terminated in consolidation, and that there was no appreciable difference in this regard whether reintervention had been resorted to or whether the condition had been left to itself, because the residual pseudarthrosis was well tolerated.

Osteosynthesis was resorted to in 118 cases, 35 per cent of these were failures of orthopedic therapy. It is interesting to note that operation was resorted to in 30 of the fractures of a single bone and in 60 per cent of those instances in which bones were broken. The osteosynthetic material used today is almost exclusively the Verbrugge plate.

Although the tendency has been to retain the original synthesis as long as possible, the author has, on occasion, not hesitated to resort to operation again; in some instances he has reintervened as often as three or four times. —*John W. Brennan.*

Nonunion of the Bones of the Forearm (Note à propos du rapport sur les pseudarthroses de l'avant-bras). J. VERBRUGGE. *Acta orthop. belg.*, 1960, 26: 273.

THE AUTHOR'S PRINCIPLES in the treatment of fresh fractures of the bones of the forearm may be summarized as follows: In adults open reduction and fixation is a must when only one bone is broken. When both bones are broken, operation is frequently necessary. Both fractures should always be fixed.

To reduce stripping of the periosteum the author's own retractors and forceps are used. He does not use coaptation plates but special concave plates with screws in alternating diagonal directions.

For nonunions metallic fixation is always used, together with bone grafts, usually from the iliac crest.

—*J. C. Mulier.*

Surgical Indications in the Sequelae of Fractures of the Shaft of the Forearm (Indications chirurgicales dans les séquelles des fractures diaphysaires de l'avant-bras). R. SOEUR. *Acta orthop. belg.*, 1960, 26: 284.

THE AUTHOR DISCUSSES 24 interventions for sequelae of fractures of the shaft of the forearm—nonunions of one or both bones, malunion, or synostosis. The treatment consisted of 19 intramedullary nailings; 1 osteotomy and reduction; 1 Phemister type procedure, a bone graft; once his own "procédé des ganses"; and twice a resection of the synostosis.

For the intramedullary nailing the author's nail with a diameter of 4 to 5 mm. or multiple Kirschner wires are used. This choice respects the normal incurvation of the bones but does not allow coaptation of the fragments.

For low fractures of the radius the author has used his "procédé des ganses"—extraperiosteal pins around

the fragments fixed with loops of wires passed through the bone.

In 85 per cent of medullary nailings consolidation was obtained, and in 82 per cent there was a satisfactory functional result. Almost the same results were obtained in fresh fractures. In some cases of limitation of pronation and supination an intentional nonunion of the ulna may be useful, after Sauvé-Kapandji.

—*J. C. Mulier.*

Injuries of the Articular Disc at the Wrist. H. M. COLEMAN. *J. Bone Surg.*, 1960, 42-B: 522.

INJURY to the fibrocartilaginous disc between the radius and ulna has long been considered a cause of disability after Colles' fracture.

The disc is fairly taut in all positions of rotation of the forearm, so that any disruption of the inferior radioulnar joint must be accompanied by injury of this structure or avulsion of one of its bony attachments. If the fingers of one hand are grasped with the other hand and the wrist is forced into extreme extension and pronation, strain followed by pain will be felt in the region of the head of the ulna. The inferior radioulnar joint is the first fixed point in the chain of articulations where the violence of the force is expended on soft structures. Tenderness localized to the dorsum of the inferior radioulnar joint is almost constantly present. The lower end of the ulna may be slightly more mobile than usual, and pushing it forwards and backwards is painful. Arthrographs of the wrist have been helpful in establishing the diagnosis when the disc is completely torn.

Of 22 patients, aged 14 to 60, who had symptoms and signs suggestive of a torn articular disc, 14 were operated upon and the pathologic lesion was demonstrated. Five types of tears were found. Detachment from the radius was most common. The superficial or microscopic tears were on the proximal surface of the disc. Fibrillation of the articular cartilage of the head of the ulna was noted once in relation to a surface tear of 10 months' duration. In only 1 case of detachment from the ulna was the ulnar styloid process seen at operation to have come away with the fibrocartilage. A completely fragmented disc was found in 1 case in which disruption of the inferior radioulnar joint had occurred in association with a fracture of the head of the radius. The radial head had been removed and the radius had moved upwards. The accurately localized pain and tenderness associated with a click in the inferior radioulnar joint make the diagnosis relatively easy.

—*C. Fred Goeringer.*

Refractures, Pseudarthroses, and Cysts of the Navicular Bone (Behandlungsergebnisse von Navikularefrakturen, -pseudarthrosen und -zysten). K. H. HERZOG. *Zbl. Chir.*, Leipzig, 1961, 86: 769.

THE AUTHOR REPORTS on 50 patients with navicular disorders treated at the Jena Orthopedic Clinic, Germany. There were 18 fresh fractures; 3 that were incomplete healed readily with immobilization, as did 6 avulsions, 1 of these by resorption of the avulsed tuberculum. Of 9 body fractures, 5 healed after 5 to 12 weeks immobilization and 4 formed pseudarthroses.

Eight patients had old fractures when first seen 1 to 6 months after injury. Two had already healed, with little functional impairment. Four healed after 11 to 13 weeks of immobilization in plaster, but, on follow-up, the patients had varying degrees of impairment of strength in fist closing, dorsiflexion and volar flexion, and radial abduction. One patient healed with a Mattiplasty; in 1 patient pseudarthrosis developed.

In this series, there were 18 patients with navicular pseudarthrosis, seen from 4 months to 7 years after the injury. They were all in fracture lines across the proximal or middle third of the navicular bone. Four were not treated because of absence of symptoms. One fracture line bridged over with bone after 200 days of immobilization. Excision of the proximal fragment, performed in 1 case, was successful. In the remaining 12 cases, 4 Mattiplasties were performed; 2 failed, requiring intramedullary bone grafts. Four bone grafts in all were performed, with good results. Two Kirschner wire fixations were successful. The author considers the intramedullary bone graft the operation of choice.

Six patients with navicular cysts were seen; 2 were not treated. Two healed with immobilization alone; 2 healed with curettage of the cysts, placement of medullary bone chips, and Mattiplasty.

There was 1 woman with a pathologic fracture caused by metastasis from a breast carcinoma.

The author believes there is a constitutional predisposition to navicular lesions. He found that these patients tend to have a greater degree of volar "tilt" to the end of their radii and a steeper radioulnar curve as compared with "normals." These wrists, with the navicular bone at "traumatic center," are more sensitive to sudden hyperextension injury, as a fall on the outstretched hand. The navicular bone shears back against the relatively sharper edge of the distal radius. The navicular bone of a patient with this kind of a wrist may be already weakened by long continued minor traumas of everyday activity; in fact, the author believes that navicular cysts are produced by this mechanism. It is interesting that of the 6 patients with navicular cysts, 4 were laborers who used the involved hand in prolonged dorsiflexion exposed to vibrations.

The customary manner of immobilizing the navicular bone is with the wrist dorsiflexed. The author believes this distracts the fragments and impairs bony consolidation, disposing to nonunion and pseudarthrosis. He says the wrist should be immobilized "straight on," which tends to pull the navicular fragments together.

—*William B. Gallagher.*

Stabilization of the Collapsing Spine. ALICE L. GARRETT, JACQUELIN PERRY, and VERNON L. NICKEL. *J. Bone Surg.*, 1961, 43-A: 474.

IN ORDER TO DOCUMENT the effect of spinal stability on function, a group of patients with severe paralysis of the trunk muscles was evaluated before and after spine fusion. In a child, an unstable spine almost inevitably results in scoliosis. Weakness of the trunk, together with flexibility, allows the spine to collapse when the patient is erect—the collapse occurring in the anteroposterior plane as well as in the lateral. Eventually, the spine becomes fixed in the collapsed position and scoliosis is diagnosed. The simplest method of treatment is to preserve the stiffness char-

acteristically present in acute and subacute poliomyelitis. Back tightness should be preserved if any weakness is present. A spine fusion should be performed if collapse occurs, before the collapse becomes a fixed scoliosis. For this reason, passive stretching to regain a mobile spine should not be performed early in the disease and should be completely avoided in patients with severe trunk paralysis.

In the discussion of the article, Moe states that the authors' dictum of the desirability of preserving the stiffness so often found in the trunk of subacute poliomyelitis must be carefully interpreted. It must be recalled that many victims of paralytic poliomyelitis who exhibit generalized paralysis make a partial or even a spectacular recovery. —*C. Fred Goeringer.*

Congenital Dislocation of the Hip. JOHN WILKINSON and CEDRIC CARTER. *J. Bone Surg.*, 1960, 42-B: 669.

THE AUTHORS, reporting from the Orthopedic Department of the Hospital for Sick Children, London, England, have studied 200 cases of congenital dislocation of the hip. Of this number only 149 were completely evaluated. There were 17 boys and 132 girls. The remaining 50 additional cases were not assessed for failure in reduction; some were secondary to arthrogryposis multiplex and spina bifida. Unilateral dislocations numbered 107, bilateral, 42.

Conservative therapy was the treatment of choice. It consisted of manipulation under anesthesia, fixed skin traction with gradual abduction of both legs, plaster, and Denis-Brown harness for 9 to 12 months.

Roentgenologically, the authors have used, with some modification, the Severin classification of grading all hips in this series into 5 grades. The higher the grading, from 1 to 5, the greater the morbidity and the greater the percentage of failure in the treatment of congenital hip dysplasia.

Conservative treatment achieved 52 satisfactory results among 54 unilateral hips when the opposite acetabulum was considered normal. Contrariwise, the end results encountered in the bilateral cases were disappointing. Of 42 patients with bilateral dislocation 19 were successes and 48 failures.

Concentric or eccentric reduction under anesthesia did not influence the end results materially. Fragmentation of the femoral head will not ensue if reduction is executed by traction and gradual abduction.

Operative interventions are advocated in (1) normal opposite hips, (2) persistent eccentric reduction after 3 months, (3) shallow opposite acetabula, and (4) bilateral hip dislocation.

This interesting article is replete with many figures, tables, and roentgenograms. —*Samuel L. Governale.*

Congenital Dislocation of the Hip. I. G. MACKENZIE, H. J. SEDDON, and D. TREVOR. *J. Bone Surg.*, 1960, 42-B: 689.

THE AUTHORS PRESENT a report on 137 patients treated for congenital dislocation of 167 hips between January 1949 and December 1953 at the Royal National Orthopaedic Hospital, London, England. Closed reduction for subluxation at less than 3 years of age gave excellent results in all patients and in 80 per cent of the patients over that age. In complete dislocation, closed reduction was satisfactory in only 58 per cent of patients under 3 years of age and could be used only in those less than 5 years of age.

Open reduction was necessary in 20 per cent of the patients under the age of 3 and can be successfully used in those up to age 6. The most unpredictable feature in the treatment of dislocated hips is the behavior of the acetabulum. Acetabuloplasty is the proper operation for a sloping acetabulum and can successfully be performed in patients up to the age of 12. Past this age, a shelf operation should be performed. These operations were required in 38 per cent of the hips treated in patients less than 3 years old and in 64 per cent of those over this age.

Excessive anteversion should be corrected by subtrochanteric osteotomy along with simultaneous correction of valgus of the femoral neck. Unilateral dislocations in patients past age 6 should be corrected by capsular arthroplasty.

Seven anatomic barriers to closed reduction have been recognized and two or more are commonly found in one hip when open reduction is performed.
—*David E. Hallstrand.*

Compression Arthrodesis of the Hip Joint. ANATOL AXER. *J. Bone Surg.*, 1961, 43-A: 492.

THE PURPOSE of this preliminary report is to describe a method of internal fixation with compression for arthrodesis of the hip joint. The compression apparatus, made of antimagnetic stainless steel with molybdenum, consists of a cannulated, massive, three-flanged nail and a cannulated quadrilateral compression screw, a compression plate, compression spring available with variable strengths, washer, and nut. Special tools are utilized. The operative technique is well described.

Since the author first described the method in 1954, approximately 20 patients have been subjected to this procedure. The analysis of 19 of the patients who have been followed up from 1 to 5 years with an average follow-up of 2 years and 3 months is given. In the earlier cases when only one incision was used, wound infection occurred in 6 patients.

Reoperations were necessary in 6 of the patients for various reasons. An incidence of fusion of 84 per cent in this small series is particularly impressive in view of the fact that external immobilization was required in only 7 of the 19 patients and partial weight-bearing was started 2 to 8 weeks after operation in 13 patients.

The results to date suggest that the addition of the iliofemoral graft improves the chances of union and may even shorten the time required for solid bone union to take place. With the exception of 1 or 2 of the hips that united solidly, roentgenographic evidence of bone fusion was present within 1 year.

This operation seems to have the following advantages: (1) once the technique is mastered it is not difficult, (2) external immobilization of the hip with plaster casts is seldom necessary; (3) walking may be permitted early, an average of 7 weeks after operation; (4) knee exercises may be started immediately after operation; and (5) if union by bone occurs it does so usually within the first postoperative year. If a self-locking iliofemoral graft is applied fusion occurs more rapidly. —*C. Fred Goeringer.*

Charnley Stabilization of the Hip. J. PIGGOT. *J. Bone Surg.*, 1960, 42-B: 476.

THE PURPOSE of this brief presentation is to emphasize the early and late complications of the Charnley stabilization encountered by the author in a series of 92 hips in 91 patients. There were 25 males and 66 females in the series. Periods of observation are a minimum of 1 year and an average of 2 years, 11.7 months. Indications for the procedures were briefly those of painful hips and uninvolved opposite hips with reasonable mobility of the knees. Cystic degeneration of the femoral head was a contraindication because of the likelihood of an ensuing stress fracture.

Degenerative changes found were: 6 congenital dislocations, 4 cases of Perthe's disease, 3 of aseptic necrosis, 3 of rheumatoid changes, and 2 of Paget's disease.

The operative procedure, with minor changes, was the classical Charnley technique. After the reconstruction a spica cast was applied down to the malleoli at 30 degrees flexion. The spica cast was shortened above the knee in about 34 days and removed 12 weeks postoperatively.

There were no immediate postoperative deaths. Other sequelae were enumerated as follows: paralytic ileus; femoral thrombosis, 9; pulmonary embolus, 5; pyrexia noted in 29 patients, perhaps caused by pelvic hematomas; and 2 wound infections. Of late complications, the author alludes to the occurrence of 8 stress fractures, limitation of knee motion in 4 patients, residual painful hips, backache, and deterioration of the opposite hip.

Clinical results showed a poor bony fusion in 17 cases with an obvious 20 to 30 degree movement of the operated on hips. In 34 patients the surgeon assessed the results as excellent, good in 31, fair in 16, and poor in 10. It must be remembered that the time of observation is short. The late complications have not reached full enough maturity for evaluation of the permanency of this most important contribution to hip arthroplasty. —*Samuel L. Governale.*

Charnley Stabilization of the Hip. J. MORTENS and E. JENSEN. *J. Bone Surg.*, 1960, 43-B: 466.

A SMALL SERIES of hip stabilization procedures is presented by the authors from the Orthopedic Hospital, Copenhagen, Denmark. Of the 43 cases, the cause of the disorder and indication for surgery was osteoarthritis in 29 cases, congenital dislocation in 5 and miscellaneous hip lesions in 9.

The technique of operation is comprised of a Gibson approach, appropriate osteotomy of the acetabulum, remodeling of the femoral neck, and immobilization of both bones under compression. In 7 cases the Charnley compression screw was resorted to. Patients treated by this procedure were all immobilized in a plaster cast for variable lengths of time. By and large, however, the period of immobilization was gradually increased with greater experience and familiarity with the end results. In 29 patients the cast was cut at the knee to permit mobility of the knee joint 3 to 4 weeks postoperatively. Walking was permitted when the knee achieved moderate return of function. All patients in the series were weightbearing by the eighteenth week.

Two patients died soon after operation. One female, aged 73, died 2 years later of cardiac causes. Of the 39 patients available for follow-up 33 were assessed as satisfactory and 6 as unaltered or worse. Bone fusion ensued in 17 of the 39 patients. In 4 hips a sound fibrous ankylosis was noted; minor absorption of the head and neck was observed in 7, gross absorption in 6, and stress fracture occurred in 5.

All of the 5 poor results were encountered in patients with a pseudarthrosis and resorption of the femoral head and neck. Since the period of observation is now approximately 4.5 years, it would be of interest to the readers to know the status of the patients 4 years hence. —*Samuel L. Governale.*

McMurray Osteotomy. ROBERT H. C. ROBINS and JAMES PIGGOT. *J. Bone Surg.*, 1960, 42-B: 480.

STUDENTS OF ORTHOPEDICS are well aware that the tenets of the McMurray osteotomy are those of abolishing painful hip and correcting deformity. Moreover, one must preserve or augment whatever motion one can. The object of this report is to assess the influence of the results of internal fixation and to show subsequent roentgenographic appearance of the hip joint.

Osteotomy was performed in 58 osteoarthritic hips, 19 ununited fractures, and 5 cases of avascular necrosis after fracture. The average age of the 81 patients, 15 of whom have died since the start of the series, was 60 years.

All of the 81 patients were operated upon at the Princess Elizabeth Orthopaedic Hospital, Exeter, England. An intertrochanteric osteotomy with medial displacement of the femoral shaft and abduction and internal fixation with a Capener nail-plate in conformity with the newly created obtuse angle of the fragments is executed. Immobilization is achieved in a spica cast for 6 weeks; henceforth, the cast is trimmed well above the knee for another 6 weeks. Walking on crutches is permitted 3 weeks postoperatively.

The complications encountered were relatively innocuous. It may be of interest that since the advent of the authors' internal fixation coupled with the McMurray osteotomy, the average time of immobilization and hospitalization has been greatly reduced.

Results of the whole series as assessed by the authors can be summarized as follows: (1) Nine of 10 patients who undergo McMurray osteotomy can envisage lasting relief from pain; (2) 75 per cent should have attained good functional results; and (3) rarely does one make the patient worse. Osteoarthritis of the hip and ununited fractures of the femoral neck are excellent indications for the procedure, but it is most unrewarding in aseptic necrosis after fracture.

—*Samuel L. Governale.*

Varus Osteotomy of Pauwels in the Treatment of Coxarthrosis (L'ostéotomie de varisation de F. Pauwels). GUILLEMINET and A. LAPRAS. *Rev. chir. orthop.*, Par., 1960, 46: 683.

IN THE TREATMENT of painful coxarthrosis the authors have advocated the use of varus osteotomy according to the technique of F. Pauwels. This report presents the long term results in 68 patients treated at the University of Lyons, France since 1950. The increas-

ing popularity of the operation is attested to by the fact that 4 patients have been followed up for 5 to 10 years, 21 for more than 2 years, and 48 for less than 2 years. Three patients underwent bilateral osteotomies.

Relief of pain was immediate and occurred in 19 of the 21 patients followed up for more than 2 years. Shortening of the leg and limping were minimized by physiotherapy. Postoperative widening of the joint space was observed roentgenologically and coincided well with relief of pain. The improvement is considered to result from the varus rotation of the femoral head which allows healthy cartilage to face the point of maximum stress in the hip socket.

This improvement may be predicted preoperatively by films which show widening of the joint space with the femur in abduction. Another favorable roentgenologic sign has been the disappearance of rarefaction in the femoral head after operation, a change that takes from 4 to 24 months. There has been a close correlation between clinical and roentgenologic improvement. Those patients who were relieved of pain during the first year and who showed a good roentgenographic result continued to do well.

—John H. Wulsin.

Postoperative Examination of Congenital Dysplastic Hips After Intertrochanteric Fixation and Derotation Osteotomy (Nachuntersuchungen von kongenitalen Hueftdysplasien nach intertrochanterer Varisations- und Derotationsosteotomie). L. KLEINE. *Zschr. Orthop.*, 1961, 94: 266.

THE AUTHOR'S SERIES consists of 110 patients suffering from congenital dysplastic hip joint, who underwent operation for correction of the torsion and the valgus position. An intertrochanteric osteotomy was performed upon these patients. The ages of the patients ranged from 2 to 38 years. The follow-up examinations showed that it was necessary to overcorrect the angle of the femoral neck to less than 120 degrees.

—Frank R. Lichtenheld.

Spontaneous Aseptic Necrosis (Les nécroses aseptiques d'apparence spontanée). C. R. MICHEL. *Rev. chir. orthop.*, Par., 1960, 46: 694.

FROM THE STUDY of 19 cases of spontaneous aseptic necrosis of the hip at the University of Lyons, France the author proposes a classification into 4 groups.

1. In children 10 to 16 years old, 3 cases, prolonged and absolute immobilization offers a good prognosis.

2. In young adults 16 to 30 years old, 5 cases, 1 bilateral, a superior pole sequestrum developed in dysplastic, poorly oriented femoral heads. Destruction of the hip follows in 18 to 24 months unless treatment is begun.

3. In adults 30 to 45 years old, 5 cases, 1 bilateral, the necrosis involved the upper one-half or two-thirds of the femoral head and was difficult to distinguish from traumatic necrosis. No arthrosis was present, and often tomography was necessary to delimit the process.

4. In the group more than 45 years old, 4 cases, an extensive capital necrosis was noted, accompanied by acetabular arthrosis. The process developed rapidly within several months after the onset of symptoms.

Because of the swift progression of the disease in patients more than 16 years of age, the author favors surgical treatment. Removal of sequestra and assorted arthroplasties have been used with modest success. Since 1958 the varus osteotomy of Pauwels has been the preferred operation in the younger age groups. If, in patients more than 45 years old who show arthritic deformity, the area of necrosis can be relieved of pressure by abduction, then the Pauwels osteotomy is likewise advised. In 6 patients so treated, the clinical results thus far have been encouraging, and in several patients roentgenologic healing of the sequestrum has been observed.

—John H. Wulsin.

The Blood Supply of the Femoral Neck and Head in Relation to the Damaging Effects of Nails and Screws. ALFREDO BRODETTI. *J. Bone Surg.*, 1960, 42-B: 794.

THE AUTHOR ATTEMPTS to evaluate damage to the femoral head by the use of the nail or screw in the treatment of fractures of the femoral neck. Sixteen injected specimens of human femoral heads and necks were examined after the insertion of a nail or screw. Vascular patterns previously described for the femoral head and neck were taken as the anatomic basis for the study. A suspension of barium and Berlin blue was injected into the aorta, the upper third of the femur was removed, and the soft tissues were dissected away. Roentgenograms were taken, the nail or screw was inserted, then removed, and serial sections were taken.

It was found that internal fixation of fractures of the femoral neck have only a slight possibility of interfering with the blood supply. This possibility can be entirely avoided by placing the nail in the central zone of the femoral head and neck, avoiding the upper and posterior quadrant of the head and the periphery of the neck. No great difference in damage potential was found between screws and nails.

—David E. Hallstrand.

Avascular Necrosis of the Femoral Head. T. J. CLAFFEY. *J. Bone Surg.*, 1960, 42-B: 802.

RECENT STUDIES of the vascular pattern of the proximal femoral epiphysis have renewed interest in the mechanism of capital necrosis after fractures of the femoral neck. Three vessel groups supply the femoral head; the lateral epiphysial vessels, inferior metaphysial vessels, and vessels of the ligamentum teres. The most conservative estimate shows that the lateral epiphysial vessels nourish at least the outer two-thirds of the femoral head.

Using necropsy specimens with intravascular perfusion and experimentally caused fractures, it was found that the superior retinaculum containing the lateral epiphysial vessels stripped off the bone and that a considerable displacement was possible without damage to or tension on the vessels. When the line of fracture reached the point where the neck turned upwards, the lateral epiphysial vessels were found completely severed.

Necrosis occurred in all the cases in which the fracture line crossed the area of penetration of the lateral epiphysial vessels and suggests that this is the most important single factor responsible for necrosis of the femoral head. Displacement of the distal fragment hardly damaged the lateral epiphysial vessels.

The nail was found to play a very limited part in causing vascular interference sufficient to endanger the vitality of the femoral head.

It is concluded that the site of the fracture line gives the best indication of the fate of the femoral head.

—*David E. Hallstrand.*

Use of Polyamide Nails in Fractures of the Neck of the Femur and in Pertrochanteric Fractures (Die Nagelung der Oberschenkelhalsbrueche und der pertrochanteren Frakturen mit Polyamidnagel). A. HEDRI. *Bull. Soc. internat. chir.*, 1960, 19: 657.

IN A SERIES of 378 consecutive fractures of the neck of the femur in a period of 10 years, stainless steel nails were used in a routine manner. Sixty-seven per cent healed with satisfactory function; aseptic necrosis occurred in 19 per cent; and pseudarthrosis occurred in 7 per cent of the cases. Mortality was 7 per cent. In 6.8 per cent, the nail slipped or broke.

Polyvinyl chloride was experimentally used for a number of years instead of metal nails, but the results were unsatisfactory. The author used a polyamide nail to which 15 per cent barium sulfate was added. The nail is shaped like a pencil and has grooves and elevations which are arranged to form a slightly spiral contour. The nail is cannulated. Special instruments are necessary to drill a hole in the cortex and to prepare a canal to receive the polyamide nail. This procedure was used in 37 cases of fractures of the neck of the femur and in 16 pertrochanteric fractures. This procedure has been used in the past 1.5 years. Most of the patients were aged 70 years or older. Satisfactory healing occurred in 78 per cent of the cases, aseptic necrosis in 13.7 per cent, and pseudarthrosis in 2 per cent. There was no slipping out of the nail. The nails cost only a few pennies. —*George I. Reiss.*

Hallux Valgus in Adolescents. F. A. SIMMONDS and M. B. MENELAUS. *J. Bone Surg.*, 1960, 42-B: 761.

A RECONSTRUCTIVE OPERATION designed to correct both components of the hallux valgus deformity and to maintain the correction is described. This operation has been performed 33 times in 6 years on children between the ages of 9 and 18 years. The authors believe, on the basis of this experience, that the optimal age for surgical treatment is between 11 and 15 years of age, and that the operation is not indicated if there is a poor range of dorsiflexion of the first metatarsophalangeal joint.

The operation consists of removal of the exostosis on the medial aspect of the distal part of the first metatarsal bone, transplantation of the tendon of the adductor hallucis muscle from the proximal phalanx through a drill hole in the neck of the first metatarsal and suturing it on the medial side, with performance of wedge osteotomy of the proximal portion of the first metatarsal bone to reduce the intermetatarsal angle. Properly carried out, the operation should hold the toe in about 10 degrees of overcorrection.

The results of the operation were considered good in 26 cases, moderate in 4, and poor in 3.

—*Einer W. Johnson, Jr.*

MUSCLES AND TENDONS

Variations in the Action of the Anterior Tibial Muscle and Their Clinical Significance (Aktionsvarianten des M. tibialis anterior und ihre klinische Bedeutung). M. R. FRANCILLON. *Schweiz. med. Wschr.*, 1961, 91:347.

IN GENERAL, the anterior tibial muscle is thought to act solely when moving the foot during the act of walking. However, extensive myokinetic examinations reveal that the action can also remain or begin in the standing phase of the walking act. After a distorsio pedis, for instance, the muscle stabilizes the foot in an effort to prevent motion. This is, of course, a pathologic phase modification, but in apparently normal individuals variants have been found which may have clinical significance. The prolonged contraction and shortened rest period of the tibialis anterior muscle could be responsible for tenosynovitis, as has been suggested earlier. Heavy use of the muscle will cause symptoms which vary in their intensity with the degree of shortening of the rest period. The so-called shin-splints swelling and pain of the prebibial muscles represent "hyperchronism."

The importance of the exact co-ordination of the action of the anterior with that of the posterior tibial muscle is stressed by the author and it is explained why the variation in the action of the posterior tibialis, which may be either prolonged or shortened and weak, will lead to a pes valgus deformity. If this coincides with an altered action phase of the anterior tibial muscle, the transplantation of the anterior tibial tendon to the navicular bone will yield excellent results in correction of the unfixed pes valgus. —*Eckhard Fischer.*

SURGERY OF THE VASCULAR SYSTEM

BLOOD VESSELS

Vertebral Arteriography by Retrograde Injection of the Right Common Carotid Artery. GEORGE T. TINDALL and HORACE B. CUPP, JR. *Radiology*, 1961, 76: 742.

RETROGRADE INJECTIONS of contrast medium were made into the right common carotid arteries of 60 patients in an endeavor to visualize the vertebral arteries. During the injections the distal right common carotid and right brachial arteries were compressed. In the majority of cases 20 c.c. of 50 per cent hypaque were used. The details of the technique are given in the article.

A vertebral angiogram of diagnostic quality was obtained in 42 patients, 70 per cent. Incomplete compression of the distal carotid artery or improper timing were responsible for the cases of poor visualization. There was good visualization of the proximal portion of the right common carotid as well as the branches of the right subclavian artery in all 8 cases in which anteroposterior roentgenograms of the chest were made. The left vertebral artery was not visualized in any of the 6 retrograde injections into the left common carotid artery; the hypaque outlined only the thoracic aorta. The carotid arteriograms obtained with the retrograde injections were comparable to those made with the needle directed distally.

The method described can adequately visualize the right and left common carotid arteries and their branches, and the right subclavian artery and its branches; the one blind spot is the left vertebral artery. The procedure is useful in patients with presumptive diagnosis of brain tumor, subarachnoid hemorrhage, or carotid thrombosis.

—*Albert M. Schwartz.*

False Block of the Internal Carotid Artery During Angiography. WILLIAM E. GANNON. *Radiology*, 1961, 76: 748.

IN THIS REPORT the author presents case histories and roentgenographic findings in patients whose internal carotid arteries failed to visualize in carotid angiography but who had no carotid occlusion.

Many theories have been proposed to explain this phenomenon. It may be due to a drop in blood pressure mediated through the carotid sinus which contains nerve endings with stretch receptors. Increase in blood pressure in the carotid system causes dilatation of the sinus and the stretch receptors are activated, causing generalized vasodilatation, slowing of the heart through vagal activity, and a resultant drop in blood pressure. This effect can be obviated by anesthetizing the carotid sinus with procaine. The drop in pressure may delay the progress of the contrast medium with failure of opacification of the internal carotid artery. If the upper border of the opaque column has a rounded or flat appearance, the possibility of a false block should be considered as should failure of the medium to progress through the external carotid system. Multiple serial films are recommended and in questionable cases the angiograms should be repeated. Measurement of the retinal artery pressures will help to rule out internal carotid occlusion.

—*Albert M. Schwartz.*

Diagnosis and Differential Diagnosis of Vascular Insufficiency of the Upper Extremities (Diagnose und Differentialdiagnose bei Durchblutungsstoerungen der Arme). H. BERGHAUS. *Zbl. Chir.*, Leipzig, 1961, 86: 641.

VASCULAR INSUFFICIENCY of the upper extremities is not an uncommon manifestation of generalized arterial disease. For example, 24.2 per cent of the patients with endangiitis obliterans reviewed by McKittrick had manifestations of the disease in the upper extremities. Because of the development of collateral circulation by way of the superficial volar and deep arches of the hand, symptoms are initially minor. Diabetic and arteriosclerotic arterial changes may lead to vascular insufficiency in the upper extremities similar to the changes in the lower extremities.

In Takayasu's "pulseless disease" obstructions of the aortic arch branches develop. The brachiocephalic trunk, the left carotid, and the left subclavian arteries are most commonly involved. The symptomatology is, in general, just the counterpart of that associated with stenosis of the aortic isthmus. In the latter case hypertension—hypotension in the upper extremities—will be determined by the prestenotic or poststenotic topography of one or both subclavian arteries. Aortic valvular stenosis, present in 6 per cent of the patients, is another determinant. Arteriovenous fistulas of the upper extremities generally produce less pronounced trophic changes than those encountered in the lower extremities.

Cervical ribs and the scalenus anticus syndrome may show, in addition to vascular manifestations, neurologic derangements.

Vascular injuries may be associated with dislocation of joints. At the time of reposition of the shoulder and the elbow, traumatic lacerations must be avoided. The brachial artery may be affected in supracondylar fractures, careful examination of the peripheral arm vessels will detect such injuries.

Toxic changes due to lead poisoning, arsenic, and ergot are mentioned. Damage due to freezing is noxious, but exposure to cold and dampness is not. Nicotine by itself can not produce endangiitis obliterans, since this disease, like obliterative arteriosclerosis, is endogenously conditioned. Nicotine will, however, aggravate the clinical course of the disease.

—*Karel B. Absolon.*

Ascorbic Acid and the Peripheral Vascular System. RICHARD E. LEE. *Ann. N. York Acad. Sc.*, 1961, 92: 295.

THE VASCULAR REACTIVITY of the vessels in the mesentery of the large and small bowel of guinea pigs and rats was studied by means of transillumination and

micromanipulation techniques. The role of ascorbic acid and certain flavonoid compounds in the vascular response to different stimuli was evaluated.

The development of scurvy is characterized by a loss of reactivity to epinephrine in the arterioles, by increased fragility of the vessels in the capillary bed, and by perivenular petechiae.

Two groups of guinea pigs, one vitamin C-deficient and the other vitamin C-supplemented, were subjected to experimental hemorrhagic shock and survival times were computed. The vitamin C-deficient animals showed a marked reduction in their ability to withstand hypotension as compared to the controls.

The response of rats to the flavonoids hesperidin and rutin, with respect to spontaneous petechiae, the clotting tendency of intravascular blood after electrical stimulation, and the reactivity to epinephrine, was evaluated. None of these parameters was affected by the flavonoid administration. Bleeding time was also measured after transection of the vessel with a microscalpel; however, there was no evidence of an increase in the bleeding time.

Blood clotting and perivenular petechiae after trauma were not influenced by vitamin C deficiency nor by the addition of hesperidin or rutin.

Vitamin C has been shown to maintain responsiveness to epinephrine, to maintain vasocompensatory responsiveness, and to maintain the tonic state of the venules. —*John H. Davis.*

Blind Ductus Arteriosus. PETER KERLEY and BASIL STRICKLAND. *Brit. J. Radiol.*, 1961, 34: 291.

IN CONGENITAL PULMONARY STENOSIS a shallow bulge frequently can be seen on angiocardiography, caused by the jet of blood passing through a narrow orifice under pressure and striking the anterior wall of the pulmonary artery well above the valves. A second projection, higher up in the artery, may be seen in pulmonary stenosis and tetralogy of Fallot; it is shorter based, deeper, and more angular and previously was thought to be caused by the reflection of the pericardium from the dilated pulmonary artery.

The authors have seen this phenomenon frequently and by roentgenographic and anatomic studies have shown that the "diverticulum" in many instances is caused by a blind ductus arteriosus filling with contrast medium from the pulmonary artery. Excellent photographs of sample cases are included in this short report. —*Albert M. Schwartz.*

Buckling of the Innominate Artery Simulating Aneurysm and Tumor. HAROLD J. SCHNEIDER and BENJAMIN FELSON. *Am. J. Roentg.*, 1961, 85: 1106.

BUCKLING OF THE INNOMINATE ARTERY is a relatively common entity that has had limited recognition. It is often mistaken for an aneurysm or a neoplasm. Three recent cases of buckling of the innominate artery encountered at the Cincinnati General Hospital, Cincinnati, Ohio illustrate the importance of recognizing the condition.

The normal innominate artery is a relatively short vessel, only 5 cm. in length. It has three points of fixation: the arch of the aorta, the right subclavian artery as it passes under the scalenus muscle, and the carotid artery, in turn fixed by the internal and external carotid branches within the neck. When, because of atherosclerosis, the thoracic aorta dilates, elongates, and uncoils, the aortic arch moves cephalad, carrying with it the origin of the innominate artery. Since it is fixed superiorly, the short innominate artery can compensate only by buckling or kinking. This process is further accentuated by atherosclerotic elongation and dilatation of the innominate artery itself.

Evidence of arteriosclerosis, hypertension, cardiac disease, and in particular a small pulsating mass in the right supraclavicular fossa or lower cervical region are helpful clinical signs. Most of the roentgenographic signs are usually present: contiguity of the mass with the aortic arch in all projections, a smooth lateral border; linear calcification; prominence of the left superior mediastinum above the aortic knob, indicating a similar process in the subclavian artery; and evidence of atherosclerosis of the thoracic aorta. Fluoroscopy is of limited value. The definitive diagnosis can be made by catheter aortography or angiocardiography. The former gives the best delineation of the arteries. Angiocardiography is the safer and simpler of the two methods and should be the first to be attempted.

Buckling of the innominate artery is a relatively frequent condition which is often mistaken for aneurysm or neoplasm. Angiocardiography is the definitive method of diagnosis. Since the entity is innocuous, its consideration in the differential diagnosis of right superior mediastinal or pulmonary masses is valuable. —*Frank L. Hussey.*

The Present Status of Aortoiliac Endarterectomy for Obliterative Atherosclerosis. JACK A. CANNON, I. G. KAWAKAMI, and WILEY F. BARKER. *Arch. Surg.*, 1961, 82: 813.

AN EVALUATION of the results in 94 cases of patients with aorticoiliac obliterative atherosclerosis treated by endarterectomy frequently combined with bilateral lumbar sympathectomy is presented. The operative technique currently employed is described and illustrated.

The patients selected for operation were divided into two groups, favorable and unfavorable. Those in the favorable group were younger, complained of claudication at a high level, usually demonstrated slightly positive oscillometry at the calves, and frequently had faintly palpable popliteal and pedal pulses. The patients in the unfavorable group were usually 60 years old or more, tended to claudicate low, had negative oscillometry at the calves, and had no palpable popliteal or pedal pulses. Postoperatively the results were considered favorable if pedal pulses were restored and unfavorable if none or weakened popliteal or pedal pulses appeared in the immediate postoperative period despite the restoration of normal femoral pulses.

The follow-up period ranged from 1 to 71 months with a mean of 30 months. In the group of 60 favorable cases good to excellent results were obtained in 97 per cent with an operative mortality of 2 per cent. In the 34 unfavorable cases good to excellent results were obtained in 68 per cent and the mortality was increased to 12 per cent. In the unfavorable group

there was also disconcerting evidence of progression of the basic disease.

The authors admit that endarterectomy is technically more difficult and time-consuming than the use of the bypass graft, but still enthusiastically prefer endarterectomy as the basic surgical approach, believing that it gives the patient increased and more lasting benefits. —*George R. Holswade.*

Autogenous Vascular Grafts (Su di una tecnica per creare innesti vascolari autologhi). A. Actis Dato, R. de Nunno, and G. Venere. *Minerva chir.*, Tor., 1961, 16:362.

This article, from the Surgical Clinic of the University of Turin Medical School, Italy, is a report of the experimental and clinical application of a new technique for making autogenous vascular grafts. The method consists in exposing the fascia lata, from which a tube is fashioned in situ around a cylinder of nylon or teflon acting as a mold. The tube is then reinforced by suturing a sheath of tantalum around it. One or 2 months later, the previously prepared autogenous tube is exposed, the upper and lower connections to the fascia lata are severed, and the mold is removed. The tube of fascia lata is then ready to be anastomosed to the particular vessel for which it was intended.

Good results were obtained in 50 per cent of the animals. The results were assessed by evidence of good pulsations downstream, by aortography, and in 2 animals by histologic examination 2 and 12 months after operation. The autoplastic graft was lined by flat cells resembling endothelium, and the tantalum mesh was intimately cemented with the surrounding connective tissue. There was no thrombosis. This method has been applied clinically in 2 patients with coarctation of aorta. The coarcted segment seemed too extensive to permit an end-to-end anastomosis. A good result was obtained in 1 patient. The other patient suffered a hemorrhage on the second postoperative day. —*Michele A. Chiechi.*

Vascular Replacement in Grossly Contaminated Wounds. Robert B. Brown, W. D. Hoofer, Jack J. Greenberg, and L. Henry Edmunds, Jr. *J. Trauma*, 1961, 1:322.

Because of the poor results obtained with freeze dried homografts and plastic prostheses in cases of wound infection after their insertion, the authors decided to use formalin preserved homografts, as the formalin inhibits bacterial growth and inactivates proteolytic enzymes.

Three groups of dogs were used in the experiment. Formalin preserved aortic homografts were implanted in clean surgical wounds in 8 dogs and in a field contaminated with feces in 20 dogs, and crimped teflon aortic prostheses were implanted in a field contaminated with feces in 20 dogs. All grafts were inserted in the abdominal aorta, the area was contaminated with feces in the latter groups, and the dogs were given penicillin and streptomycin to prevent overwhelming infection.

Six of 8 control animals had functioning homografts when sacrificed 1 year postoperatively. Six dogs in each contaminated group died prematurely; in 5 of each set, death was due to peritonitis or septicemia. One animal in each contaminated group died of hemorrhage. Fourteen survivors in each group had patent replacements. None of the animals with homografts had residual pus at 6 months, but prostheses in 2 were surrounded by purulent material within a thick fibrous mass.

The authors conclude that, although formalin preserved homografts apparently have an increased resistance to infection, they are not uniformly superior to plastic prostheses and they do not recommend their use in contaminated wounds in preference to the plastic prostheses when the latter are available. —*Albert M. Schwartz.*

Histological Observations of Aortic Teflon Grafts in Normal Dogs After 5 Years. Bernard M. Wagner, Kirk E. Evans, Karl J. May, Jr., Milford S. Ofstun, and K. Alvin Merendino. *J. Surg. Res.*, 1961, 1:53.

This report deals with 5 dogs who survived 5 years after implantation of unpurified brown teflon thoracic aortic grafts. All grafts were patent, there was no excessive fibrous tissue deposition, the pseudointima was smooth though of irregular thickness, there was no evidence of calcification, gross changes of atherosclerosis, or aneurysmal dilatation, and the teflon cloth had retained its pliability.

On microscopic examination some early calcification was seen about the grafts, but no degeneration of the teflon fibers was found. No definite endothelial lining was present on the intimal side of the graft; the pseudointima was largely composed of fibers, ground substance, and isolated fibrocytic nuclei. An active process of collagenization invested the grafts with a vascularized adventitia and a relatively acellular type of intima. If additional degenerative changes occur after 5 years they must proceed at an extremely slow rate. These findings tend to substantiate earlier observations regarding the highly desirable attributes of teflon as a vascular prosthesis. —*Albert M. Schwartz.*

LYMPHATIC VESSELS AND NODES

Lymphography in Venous Diseases of the Lower Extremity (Studio radiologico del sistema linfatico nelle flebopatie degli arti inferiori). A. Toti, M. Fabi, G. Bagni, and G. Vita. *Radiol. med.*, Milano, 1961, 47:10.

The authors, from the University of Ferrara Medical School and the Arcispedale S. Anna, Ferrara, Italy, report a roentgenologic study of the lymphatic system of the lower extremity in 11 patients with various venous diseases, chiefly postphlebitic syndrome and varicose veins, in order to assess the effect of the venous disease on the lymphatics. Visualization of the lymphatic trunks was obtained with the following technique. A few minutes after 0.5 c.c. of sky blue dye is injected into the first interdigital space, a longitudinal incision is made on the dorsum of the foot; the stained subcutaneous lymphatic can then be easily isolated, cannulated, and injected with from 3 to 9 c.c. of contrast medium. Exposures are made from 5 to 10 minutes after the injection.

Venous disease produces functional and morphologic changes in the lymphatic system. The former consist chiefly of lymphostasis and early perilymphatic diffusion of the contrast medium. The latter are represented essentially by dilatation, irregular course, and uneven caliber of the lymphatics. These changes are due to periphlebitic alterations and to the extrinsic pressure of varicosities upon the lymphatic channels. All these changes involve the superficial system of lymphatics, which follows contiguously the course of the superficial veins of the extremity. The deep subfascial system, normally of limited importance, is not affected.

The authors believe that the functional changes are more important than the morphologic changes. The perilymphatic diffusion of the contrast medium, which is a normal finding, occurred very early in the cases reported and was marked in cases with edema of the extremity. The phenomenon is perhaps due to an as yet poorly understood alteration of the humoral exchanges between the lymphatic system and the interstitial fluids. This increased permeability of the lymphatic trunks plays an important role in the occurrence of postphlebitic edema according to the authors.

Other factors, such as local anoxia and reflex spasm of the lymphatic channels originating at the level of the venous thrombosis, should be kept in mind in the pathogenesis of the postphlebitic edema. These elements, however, require further investigation in order to be accepted as important factors in the mechanism of edema formation of the postphlebitic leg. —*Michele A. Chiechi.*

BLOOD AND TRANSFUSIONS

Modern Mythology of Blood Groups (Mythologie moderne des groupes sanguins). ALEXANDER S. WIENER. *Gyn. obst.*, Par., 1961, 60: 150.

IN THIS ARTICLE the author attempts to refute modern misconceptions about blood groups. He deplores vehemently the association of certain diseases with specific blood groups. For example, he cites the reported higher incidence of ulcers in type O and of gastric cancer and salivary tumors in type A. He bases his argument on the fact that mathematicians reach certain conclusions in serology even though they are totally ignorant of the subject. Serologists, however, know from their experience in the laboratory how to avoid drawing conclusions based on purely mathematical probability. He also points out the fallacies brought about by simplification of the Rh factors by using the CDE system instead of the Rh-Hr system, as originally described by the author himself. He mentions that when the CDE system was suggested there were only 4 known Rh factors while at present 18 factors are known. He quotes the recommendation of the Committee on Medicolegal Problems to utilize exclusively the author's classification and to discard the CDE classification. He cites the possibility of contradicting results when using the two systems in cases of disputed parenthood.

—*Joseph J. Bahuth.*

Can Irregular Antibodies Develop in the Donor Plasma in a Transfusion Reaction? (Koennen irregulaere Antikoerper im Spenderplasma Transfusionsreaktionen hervorrufen)? W. SPIELMANN and W. FRITZSCHE. *Med. Welt*, 1961, p. 874.

WHEN blood from 45,000 donors was examined, 48 cases of irregular antibodies were found at a temperature near 37 degrees C. In 29 cases a genuine immune antibody; in 14 cases pure anti-D; in 13 cases anti-D and C and/or anti-E; and in 2 cases an anti-C antibody were isolated. Nineteen cold antibodies with an elevated heat amplitude, but in which an immunization could not be demonstrated, were isolated. Two were anti-Lewis, 6 anti-P, and 11 anti-H. Two patients tolerated donor blood with antibody serum without subjective symptoms. Although the first patient with the group ACcDee received donor blood with an anti-C titer of 1 to 4 to 1 to 8, no breakdown products of hemoglobin were found in the serum or urine, although the hemoglobin rose as expected. The second patient with the group ACcDee received anti-D donor blood with a titer of 1 to 8 to 1 to 32. A slight rise of indirect bilirubin to 1.76 mgm. per cent occurred on the second day but the bilirubin returned to a normal level on the third day.

On the basis of these observations one must assume the probability of a genuine transfusion reaction with the transfer of incompatible immune antibodies in the donor's serum. It is therefore recommended that the serum of all donors be examined for immune antibodies with the aid of finer methods. In the advent of positive findings the blood should be marked as such. Complete crossmatching for routine transfusions would be considered superfluous. It would seem advisable to determine the Rhesus subgroups of the donor and the recipient. —*Andrew P. Adams.*

SURGICAL MANAGEMENT

PREOPERATIVE AND POSTOPERATIVE CARE

Physiologic Considerations in the Management of Patients with Corticosteroid-Induced Adrenal Suppression Who Undergo Operation. LEON J. MARKS, JOHN W. HEIZER, and LEONARD BRAUNSTEIN. *Surgery*, 1961, 49: 657.

THIRTEEN PATIENTS, ranging in age from 27 to 68 years, who underwent extensive or less extensive operations during prolonged corticosteroid therapy form the basis of this report. The patients had been on steroid therapy for 1 week to 7 years prior to operation.

The plasma free 17-hydroxycorticosteroids (17-OHCS) were measured in the patients as well as in a group of controls. The control values averaged 18± 5 gamma per cent. The effect of a standard infusion of ACTH on the level of free plasma 17-OHCS was measured in 12 of the patients. The response to the ACTH test was diminished in 11 of the patients. In addition, the free plasma 17-OHCS were lower in 9 of the patients postoperatively than would be expected from normal patients undergoing similar procedures.

Two of the patients did not receive supplementary therapy during the surgical procedure and, even though the procedure was of a minor nature, postoperative complications developed in these 2 patients.

The studies also suggest that prednisolone can exert a protective effect on the ability of a patient with adrenal insufficiency to withstand a major surgical stress for many hours after free plasma 17-OHCS values have fallen to within the lower range of normal. The authors suggest that the newer cortisol analogues, such as prednisolone, are capable of influencing metabolic processes at the cellular level even though the drug has disappeared from the blood. —*John H. Davis.*

The Treatment of Cardiovascular Collapse with Synthetic Hypertensin II (Essais d'utilisation de l'hypertensine II synthétique dans le traitement du collapsus cardio-vasculaire). S. KARPMAN-BOUTET, R. NEDEY, and G. VOURC'H. *Anesthésie*, Par., 1961, 18: 24.

SYNTHETIC HYPERTENSIN II (valine 5-angiotensin II amide) was used in 7 cases of severe, prolonged shock. The patients ranged in age from 18 to 67 years. Shock developed in 5 patients after extensive operation (pneumonectomy 1, lobectomy 1, craniotomy 2, and hemicolectomy 1). Shock developed in 1 patient after bronchoscopy and in another after intoxication with trichloroethylene. At the time hypertensin II was administered, 5 patients were clinically moribund and they had failed to respond to intravenous infusions of neosynephrine and/or norepinephrine. Hypertensin II was given in doses ranging from 1 to 12 mcgm./min.

In 6 patients, in spite of the desperate clinical condition, hypertensin produced a pressor response. In 1 patient there was no response. Four patients, although showing a pressor response to hypertensin II, deteriorated further and died. Two patients, however, recovered from shock and survived.

Cardiac function was monitored by electrocardiogram in 3 patients. In 2 it was noticed that during the infusion of angiotensin there was some flattening of the ST segment and the T wave. In the other patient who had shown multiple arrhythmias in the course of norepinephrine infusion, infusion with hypertensin II failed to produce any change on the electrocardiogram. The authors emphasize that hypertensin II is a powerful vasopressor, superior to the previously known pressor agents in that it is capable of producing a pressor response in moribund patients. Further, hypertensin II produces electrocardiographic changes far less frequently than norepinephrine.

—*F. del Greco.*

WOUNDS AND THERMAL INJURIES

Early Differentiation Between Necrotic and Viable Tissue in Burns. DICRAN GOULIAN, JR. *Plastic & Reconstr. Surg.*, 1961, 27: 359.

THE SEARCH for early, accurate evaluation of the degree of burn involvement has given rise to a number of inadequate diagnostic aids. In this study an instrument was devised capable of giving a reliable standard burn, which was full-thickness in the center and of partial thickness in the periphery, on the side of an adult rabbit. T1824 dye was injected at varying times after this injury and the result analyzed. The findings indicated that any test which depends on superficial dermal vascular patency as a criterion for viability is invalid unless it is performed during the critical period when the deep partial thickness involvement may be converted to a full thickness loss as a result of local vascular stasis. In the case of the standard burn in the rabbit, this critical period is found to be about 6 hours. After this time, the full thickness skin burn takes no stain, whereas the partially burned tissue accepts the dye readily. There is an unexplained biologic variation in the rate of involvement between the fourth and sixth hours after the burn which is not understood and for which further work is planned.

With this in mind a single case of localized burn was analyzed after 8 hours of injury. This technique permitted the differentiation of the full thickness skin loss and the institution of immediate treatment, thus permitting the patient to be discharged from the hospital in 1 week.

The author concludes by stating that the relatively discrete, colored boundary between viable and nonviable tissue which can be demonstrated with this technique may provide the surgeon with a dependable method of assay of burn involvement early after injury. It will thus be possible to excise full-thickness involved areas in more diffuse and extensive burns earlier and more accurately. —*Carl Schiller.*

A Series of 77 Full Thickness Skin Burns with Necrectomy Immediately After Electrolyte Stabilization. MERTON L. GRISWOLD, JR. *Plastic & Reconstr. Surg.*, 1961, 27: 374.

SINCE 1956, this treatment program in one hospital has been instituted in the hopes of decreasing the number of bed days for the burn patient. The results were compared with those of a similar series of 77 patients who had been treated in the 5 years prior to this time. The principal procedural change was earlier necrectomy, which was performed when the patient's general condition permitted the administration of an anesthetic. In practice this has usually been performed between the third and the seventh post-burn days.

The morbidity figure seems to be lower since the average hospital stay has been reduced by about 6 days, 21 per cent, despite a slight increase, 4.8 per cent, in average surface burns. However, there has been only a small reduction, 1.3 per cent, in mortality. Since these burns, with a single exception, involved less than 25 per cent of the body area, this low percentage burn area group would show a low mortality under any therapeutic regimen. However, the study seems to indicate that early necrectomy of the patient with a burned surface of less than 25 per cent is a safe procedure and that it has contributed an appreciable reduction of the hospital stay.

—*Carl Schiller.*

Coagulation and Thromboembolic Complications Among 234 Burned Patients (La coagulation et les complications thrombo-emboliques chez 234 brulés). G. PESSEREAU, J. VIGNE, R. MONTEIL, and FRANCFORT. *Presse méd.*, 1961, 69:1019.

THE AUTHORS record the incidence of thrombophlebitis and pulmonary infarction in 234 burned patients treated at the Hôpital Militaire Percy, Clamart, France. The effect of anticoagulant therapy in lessening the incidence of thromboembolic complications is assessed.

Some of the patients were studied by serial measurement of prothrombin time, clotting time, heparin tolerance test, and thromboplastin activity. The results of these tests are not recorded but hypercoagulability is described as frequent in extensively burned patients.

Thromboembolic complications did not develop in any of the 150 patients with less than 15 per cent of the body surface.

Thirty-six patients with burns exceeding 15 per cent did not receive anticoagulants. They had a complication rate of 16.6 per cent. Thrombophlebitis developed in 6 and 1 of these had a pulmonary infarction. Forty-eight patients with burns exceeding 15 per cent received prophylactic heparin and coumarin. They had a complication rate of 4.2 per cent. Thrombophlebitis developed in 1 and another had a pulmonary infarction. Diffuse bleeding from the wounds, seen in 4 patients whose burn extent exceeded 60 per cent, was attributed by the authors to the burn injury and not to anticoagulant therapy. Epistaxis occurred in 1 patient with a burn of less than 60 per cent who received anticoagulants.

The incidence of thromboembolic complications in extensively burned patients is attributed to injury of the vessels, especially from venous indwelling catheters, to blood stasis, and to hypercoagulability.

The authors advise prophylactic anticoagulant therapy for all patients whose burns exceed 15 per cent.

—*Jerome J. DeCosse.*

INFECTIONS AND ANTIBIOTICS

The Management of Tetanus. B. S. CLIFTON. *Med. J. Australia*, 1961, 1: 618.

THE AUTHOR REPORTS a description of practical and certain theoretical aspects of the management of tetanus as carried out in his own hospital.

On the patient's admission to the hospital, rapid control of painful rigidity is obtained by the intramuscular injection of diallylbarbituric acid and the intravenous injection of chlorpromazine, each 1.5 to 2.0 mgm. per kgm. of body weight. A subcutaneous test dose of 0.5 ml. of 1:50 antitetanus serum is given. If the muscular irritability is not controlled by these measures, tubocurarine is started. The relaxation therapy is continued unabated for 16 days and then gradually withdrawn over a period of 7 to 10 days.

A tracheostomy is probably required in all except the mildest cases of tetanus, and the slightest evidence of a spasm of the diaphragm is an urgent indication.

As far as specific treatment is concerned, the result of the sensitivity test is examined and, if negative after 45 minutes, 100,000 units of tetanus antiserum are infused in 250 c.c. of normal saline.

The wound of entry is treated on general surgical lines by excising or draining wherever an indication exists. If practicable, 10,000 units of tetanus antiserum are infiltrated locally. Procaine penicillin, in a dosage of 1,000,000 units every 8 hours, is given for 7 days. Active immunization with tetanus toxoid is started 8 weeks after the therapeutic dose of antiserum.

—*Matthew H. Evoy.*

Postoperative Sepsis. R. J. HENDERSON. *Brit. J. Surg.*, 1961, 48: 362.

THE PRIMARY PURPOSE of the study reported was to determine the relative effectiveness on the incidence of postoperative sepsis of various types of preoperative preparation of the skin. The study was conducted on the surgical services of two general hospitals with a combined capacity of 470 beds, and virtually all admissions were included in this study during an 18 months' period beginning in November 1957.

Two per cent iodine in 70 per cent alcohol was compared with four other skin preparations which had been in common use by the four surgeons concerned in this study. These other skin preparations were: (1) cetavlon plus watery cetavlon, (2) 95 per cent alcohol, (3) 1 per cent acriflavine in 70 per cent alcohol, and (4) cetavlon. Of 1,811 cases studied, 230 or 12.7 per cent became septic or infected. Comparison of the five types of skin preparations used showed no significant differences insofar as the rate of postoperative infections was concerned. The introduction of the iodine alcohol skin preparation did not diminish the rate of these infections. Approximately 70 per cent of the sepsis was due to Staphylococcus aureus.

Other factors concerned with postoperative infections were also studied. These included contamination

of the surgeon's gloves, the blankets, and the air in the operating rooms and wards. The palms of the surgeons as well as the inner aspect of the gloves were cultured after completion of surgical procedures lasting at least 1 hour. Of a total of 405 swabs, 41 per cent were sterile, 10 per cent showed Staphylococcus aureus, and 40 per cent micrococci. The phage types isolated were the same as those causing wound infections. These swabs were taken from 10 individuals, including the four surgeons and six assistants or nurses. One surgeon and one nurse were particularly heavy carriers, and the use of hexachlorophene for the scrub resulted in virtually 100 per cent sterile cultures of hands and gloves after operations.

A study of blanket contamination was conducted by the use of sweep plates of the top blankets of all beds in 11 surgical wards of these two hospitals, and in three medical wards for comparison. This study was repeated after sterilizing processes for the blankets were well established in both hospitals, with blankets being sterilized on discharge of every patient or after 3 weeks for long-stay patients. About half of the blankets studied in each instance showed approximately 50 per cent contamination with Staphylococcus aureus, so that sterilization seemed to be of little effectiveness. The blankets in eight of the surgical wards were heavily infected and those in three wards moderately so. Surprisingly, the blankets in the medical ward were also heavily contaminated. It was noted during these studies that the length of time that the blankets had been on the bed bore little if any relationship to the incidence of positive cultures.

Studies of air contamination in the wards and operating rooms showed very heavy contamination with Staphylococcus aureus in both areas in both hospitals.

The author believes that there is little hope that individual measures will be of value as long as the depots of sepsis, the patients themselves, are allowed to remain in the wards. When patients discharging large numbers of Staphylococcus aureus are allowed to remain on the wards, the build-up of these organisms becomes very heavy, with spread to every corner of the hospital. The author believes that prompt and effective isolation must be the first and most important measure in the control of this problem.

—*E. Thomas Boles.*

HYPOTHERMIA

The Technique of Controlled Hypothermia in Brain Operations (Zur Praxis der kontrollierten Hypothermie bei Hirnoperationen). E. KLAR, G.-A. KRÜGER, and J. MLETZKO. *Langenbecks Arch. klin. Chir.*, 1961, 296: 584.

THE AUTHORS report 29 cases of intracranial operations in which hypothermia was applied and discuss the technique and the results. On the evening before the operation, 100 mgm. of demerol, 50 mgm. phenergan, and 0.6 mgm. hydergin are given to block the patient's vegetative nervous system, and this procedure is repeated at 3 to 4 hour intervals. After the patient is anesthetized and intubated the body is cooled with a cooling blanket to 30 degrees C., however, the operation is started when a temperature of 34 to 33 degrees C. is reached. Throughout the procedure, a slow infusion is running, containing 1 to 2 gm. novocaine, 200 mgm. demerol, 100 mgm. phenergan, and 1.2 mgm. hydergin in 500 c.c. of fluid. The blood pressure is usually around 80/60 mm. Hg. Special attention is devoted to the process of rewarming to avoid shock and cardiac arrhythmias which threaten when the patient is rewarmed too fast. The patient is taken off the operating table with a body temperature of between 31 and 33 degrees C., and all external heat is removed when a temperature of 34 degrees C. is reached.

With this technique, postoperative hyperthermia developed in only 1 patient. There was no evidence of brain edema or compression. Electroencephalographic tracings which showed evidence preoperatively of general changes had a tendency to be normal during the hypothermia. The tracings in the postoperative phase did not differ from tracings obtained from patients who were operated upon without hypothermia.

In 7 patients, diffuse parenchymatous hemorrhages occurred which were easily controlled by protamine sulfate and which were not followed by postoperative hemorrhages or thromboses. This suggests that the heparin-antithrombin titers are elevated during hypothermia. Gastric hemorrhage or liver damage, which has been reported after operations in the region of the vegetative nuclei, was never observed.

The authors conclude from their limited experience with 29 patients who were operated upon within 2 years that controlled hypothermia is a valuable technique which should be used in cases in which the preoperative course, the planned operation, and the expected postoperative course make a multitude of complications relating to the vegetative system possible.

—*Eckhard Fischer.*

ANESTHESIA

Techniques of Endobronchial Anesthesia. T. T. CURRIE. *Austral. N. Zealand J. Surg.*, 1961, 30: 241.

THE AUTHOR reviews the methods of endobronchial anesthesia which are available and discusses the indications for, and development of, endobronchial anesthesia. He stresses the need for wider use of endobronchial methods so that difficult cases can be managed more efficiently. The article is illustrated by reports of recent cases in which endobronchial anesthesia was considered to be essential by the author.

Endobronchial techniques are used to control pus, blood, or secretions arising from the lung and pleural cavity on the side of operation; to control the airway in large bronchopleural fistulas; and to prevent tension pneumothorax or tension cyst in operations for emphysematous bullae and air cysts.

One-lung anesthesia was first reported in 1931 by Waters and Gale of Madison, Wisconsin. Since that time the development of this technique has been rapid and progressive and the need obviously exists for such specialized techniques in controlled anesthesia.

By choosing one of the many methods described in this article for endobronchial anesthesia the following advantages may accrue: 1. Ventilation of the normal lung can be controlled at all times. 2. The lung on the side of operation can be deflated to give a quiet, adequate exposure. 3. The lung on the side of operation

may be expanded in certain techniques to indicate intersegmental planes. 4. The surgeon can aspirate the bronchial tree through the stump of the resected bronchus without interfering with ventilation. 5. The open bronchial stump can be sutured at leisure. 6. The bronchial stump can be tested for leaks without withdrawing the endobronchial tube into the trachea if the anesthetic tube has a tracheal as well as a bronchial cuff.

Five different case reports illustrating various techniques, methods, and indications for endobronchial anesthesia are included. —*Donald M. Clough.*

Intrathecal Use of Xylocaine. GUNTER CORSSEN and MORRIS S. MIEHL. *Texas J. M.*, 1961, 57: 348.

THE PURPOSE of this clinical study was to evaluate the intrathecal use of xylocaine with special reference to its efficiency and safety in predicting the desired level of analgesia. Hyperbaric xylocaine was administered intrathecally to 103 patients selected at random. Sensory analgesia with partial or complete motor paralysis of similar dermatomes was obtained in 102 patients within 3 to 5 minutes. Satisfactory analgesia was lacking in only 1 patient.

As to the level of analgesia, there was evidence that the drug behaved differently from other intrathecally administered local anesthetics. Previous experience with equipotent dosages of hyperbaric procaine and tetracaine showed that by employing a standard technique, the level of analgesia could be predicted consistently. In more than 50 per cent of the cases in which spinal anesthesia was induced with hyperbaric xylocaine, the sensory level obtained was higher than anticipated. In approximately one-third of the patients, the drug failed to become fixed at the level established 5 minutes after intrathecal injection. In these instances, a gradual ascension of the sensory level of 2 or more thoracic segments could be observed as late as 60 minutes after intrathecal injection.

The superior diffusibility of xylocaine, one of its valuable properties for facilitation of conduction analgesia, appears to be disadvantageous in spinal anesthesia because of the tendency of the agent to spread beyond the desired limits. Its use for spinal anesthesia should be discouraged since safer and equally potent drugs are available for this purpose.

—*Mary Frances Poe.*

Further Observations on Xylocaine, an Established Anesthetic Agent, in Comparison to Other "Caines." LOREN W. GRUBER. *Acta. anaesth. scand.*, 1961, Suppl. 7.

THE BASIC FORMULAS of all hitherto known local anesthetic drugs are shown to be of the same basic chemical configuration. Their analogues and homologues with the myriad of possibilities can run into the hundreds. The best known and most clinically used local anesthetic drugs are discussed, presenting their strong points, weakness, and pharmacology.

The synthesis and development of xylocaine (lidocaine, lignocaine) in 1943 by Swedish chemists was a different approach to the field of local anesthesia, involving the introduction of an amido group type of drug neither containing an ester linkage nor any form of the benzoic acid or aminobenzoic acid radical components. Xylocaine, therefore, is the first nonester type of local anesthetic agent to be used in the practice of medicine and dentistry. According to laboratory data, it is the most stable local anesthetic known. Unlike the "caines" with the ester group, xylocaine may be preserved for any length of time at any *pH* value. The *pH* is stable in xylocaine aqueous solutions but not in the ester types of drugs. It will withstand heat sterilization and is compatible with all vasoconstrictors. Xylocaine's blocking action is superior to other commonly used drugs in rapidity, onset, profundity, extent, and duration. Solutions of half the strength of procaine should provide equivalent anesthetic potency. There are few side effects. A sedative action, rather than the central nervous system stimulation common to other local anesthetics, is considered advantageous.

Potential usages have been explored and further developments with xylocaine as a topical and injectable anesthetic agent are expected.

—*Mary Frances Poe.*

INSTRUMENTS AND APPARATUS

Measurement of Blood Volume with a New Apparatus. JOHN A. WILLIAMS and JACOB FINE. *N. England J. M.*, 1961, 264: 842.

A NEWLY DEVELOPED semiautomatic device for measuring red cell or plasma volume by means of a radioisotope dilution principle is described with regard to its design, operation, and accuracy of performance. Radioactive iodinated serum albumin, I^{131}, or chromium 51 red cells are used. A scintillation counter measures the amount of activity in a preloaded syringe and after injection of the test dose the syringe is rescanned to determine the amount of radioactivity left.

All potential sources of error are taken into account including uncertainties of statistical counting, volumetric variations in sample containers, errors in automatic timing, and uncertainties in the meter indication of the result. The instrument is a self-contained, mobile, diagnostic facility ready for instant use and easily operated by personnel of ordinary technical competence.

Illustrative samples from studies in more than 100 patients are presented. —*Allan D. Callow.*

RADIOLOGY

DIAGNOSTIC ROENTGENOLOGY

Roentgen Evaluation of Pulmonary Arterial Pressure in Mitral Stenosis. PHILIP M. JOHNSON, ERNEST H. WOOD, BERNARD S. PASTERNACK, and MORRIS A. JONES. *Radiology*, 1961, 76: 541.

QUANTITATION of pulmonary hypertension in mitral stenosis is of clinical importance not only for determination of the severity of the mitral block but also for prediction of the reduction in pressure to be expected after valvulotomy. The demonstration of resting obstructive pulmonary hypertension, therefore, has become established as a major indication for surgical treatment in this form of rheumatic heart disease. If a main purpose of cardiac catheterization in mitral stenosis is the mensuration of pulmonary arterial pressure, then an accurate roentgenologic method for its prediction would be of significant value.

The authors review attempts made in the past to relate roentgen findings to pulmonary arterial pressure and report the value of newly devised multiparameter formulas for that purpose. Twenty-seven years ago Kerley stated, with respect to the chest roentgenogram in mitral stenosis, that after a severe attack of passive hyperemia the shadows of the perivascular lymphatics persist as fine sharp lines, most marked at the bases and near the hila. "Kerley's lines" consist of A-lines, or radiating perihilar lines, and B-lines or peripheral basal lines. Pulmonary venous hypertension of any cause may produce B-lines. B-lines are rarely if ever seen in uncomplicated pulmonary arterial hypertension. The development of B-lines in mitral stenosis is presumptive evidence of pulmonary venous hypertension. Attempts to calibrate B-lines in terms of coexistent pressures within the pulmonary circulation have shown that the presence or absence of these lines correlates somewhat more closely with the level of pulmonary "capillary" pressure than with mean or diastolic pulmonary arterial pressures. There is a range of pulmonary "capillary" pressures above which B-lines are usually seen and below which they rarely appear; this is approximately 20 to 30 mm. of Hg.

The pulmonary right hilar shadow is narrower in normal persons than in patients with various cardiac diseases. Dilatation of the right descending pulmonary artery branch in mitral stenosis is the most accurate roentgenologic index of pulmonary hypertension.

Another objective roentgen parameter which yielded a strong correlation with mean pulmonary arterial pressure in 56 cases of mitral stenosis, is the PA/chest ratio. The PA/chest ratio is defined as 100 times the length of a line originating at the perpendicular to the body midline and terminating at the lateral most aspect of the "pulmonary artery segment" divided by one-half the transthoracic diameter. A regression equation was found which, according to Moore and his associates, provided a fairly accurate estimate of mean pulmonary arterial pressure.

—*James H. Holman.*

Use of "Radiopaque Streamers" to Show Blood Currents in the Heart. T. DOBY. *Radiology*, 1961, 76:968.

A TECHNIQUE has been devised in which streamers are attached to the tip of a cardiac catheter to indicate the direction and strength of blood currents in the heart, similar to the manner in which banners attached to the tips of the masts of yachts indicate the direction and strength of the wind. The method has proved satisfactory for animal experimentation but the possibility of utilization in human diagnosis needs further examination. The technique consists of fraying the end of a fine nylon thread and then dipping it into white lead. After a 24 hour drying period, the end is dipped again, resulting in a lead deposit approximately 2.5 mm. at the end of the thread. The dry droplet is dipped into Duco cement and dried for 24 hours to give a smooth surface and prevent clotting of blood. The nylon thread is then cut to the desired length and glued with Duco cement into the tip of the catheter. As many as 7 streamers of varying lengths have been used, but 2 were used in most instances.

The catheter is sterilized in zephiran for 6 hours and then the streamers are dipped into heparin. The catheters are inserted through femoral or brachial veins into the heart. During insertion, the streamers lie by the side of the cardiac catheter, but immediately after it enters the heart chambers, they will be carried to and fro following the blood current. A cine film can be taken through an image amplifier and one can follow the movements of the radiopaque dot easily.

—*Lois Cowan Collins.*

Automatic Electrocardiographically Timed Coronary Angiography. NEVILLE J. JACKSON and RICHARD COBBOLD. *Canad. M. Ass. J.*, 1961, 84: 1351.

IN LIGHTLY ANESTHETIZED DOGS polyethylene 260 catheters have been introduced through peripheral arteries into the ascending aorta. The catheter is connected to a pressure recorder, advanced through, and then withdrawn from the aortic valve until the pressure tracing indicates that the catheter holes are situated immediately above the aortic valve. Fluoroscopic control is thus unnecessary. Hypaque 50 per cent is injected during diastole when coronary filling is taking place. Injection timing and duration are controlled by an electronic device into which the R wave of the electrocardiogram is fed as a triggering signal. The method has not yet been used in patients. Illustrative arteriograms are included, together with a brief discussion of other techniques of coronary arteriography.

—*Allan D. Callow.*

Translumbar Aortography: Re-Evaluation. ARTHUR C. BEALL, JR., GEORGE C. MORRIS, JR., E. STANLEY CRAWFORD, DENTON A. COOLEY, and MICHAEL E. DE BAKEY. *Surgery*, 1961, 49: 772.

THE AUTHORS' EXPERIENCE with 2,400 aortograms is divided into 3 periods by the technique of translumbar aortography used. Up to 50 ml. of contrast material and occasionally multiple injections were used for the

first 300 procedures. There were 3 deaths in this period. Another 3 deaths occurred during a transitional period in which various changes in technique were being employed, including low aortic injection. With the standardization of the present technique, into which several safeguards were introduced, 1,625 consecutive translumbar aortograms have been performed without a single death or major complication.

In order to achieve such safety several factors are of the utmost importance. The patient should be well hydrated prior to the procedure. The aorta should be punctured several centimeters proximal to the celiac axis. No more than 30 ml. of contrast material should be injected, and a second injection should be strictly avoided.

Translumbar aortography is not a procedure to be undertaken indiscriminately, but it should not be denied to those who might benefit from its use. It remains a most useful procedure and, with care, can be carried out without fear of death or serious complication.

—Harold Laufman.

Venoangiography. ALVARO RONDEROS, EDGAR W. BRANYON, JR., J. THOMAS CARLIN, JR., and JAMES DOYLE. *Am. J. Roentg.*, 1961, 85: 1097.

THE TECHNIQUE, experience, and results in a series of 109 venoangiographies performed in the Radiologic Department of the University Hospital, Birmingham, Alabama between August 1959 and May 1960 are reported.

Under local anesthesia with 1 per cent novocaine, the right antecubital vein is isolated and a Lehman No. 9 catheter inserted through the basilic vein into the axillary vein or, preferably, into the superior vena cava. The fluoroscope is used when desired to determine the location of the tip. An injection of 95 to 100 ml. sodium and n-methylglucamine salts of diatrizoic acid diluted with 70 to 75 per cent solution and warmed to 37 degrees C. is made using a pressure injection. A series of 12 roentgenograms is taken with intervals of one-half to 2 seconds between exposures.

For visualization of the thoracic aorta and neck vessels, the first angiogram of the series is taken 5 seconds after completion of the injection. When the abdominal aorta is the object of study, the series is usually started 8 seconds after completion of the injection.

Sixteen of the 109 venograms were considered to be unsatisfactory for roentgenologic interpretation.

The complications experienced in the series of cases were not severe. There were no allergic reactions.

—Frank L. Hussey.

The Diagnostic Value of Lymphangiography. LAIRD JACKSON, SIDNEY WALLACE, BURTON SCHAFFER, JOHN GOULD, and Others. *Ann. Int. M.*, 1961, 54: 870.

THE AUTHORS BELIEVE that the roentgenographic demonstration of the lymphatic system has proved to be a new and useful diagnostic tool and present their experience with 140 patients.

The method consists of the injection of a mixture of Evans blue and 1 per cent procaine solution into the web of a toe and the open exposure of dye-stained lymphatic vessels in this area approximately 30 minutes later. A 25 or 30 gauge needle is introduced and secured with a ligature. The radiopaque material used in this report is ethiodol in 37 per cent strength. This material is forced into the lymphatic system at a rate of approximately 7 c.c. per hour. Roentgenograms of the leg and abdomen are then taken at the completion of the injection of 10 c.c. and again 24 hours later. The oil contrast medium has satisfactorily delineated the architecture of the individual lymph nodes and has retained its radiopaque qualities for several weeks and hence has allowed repeated roentgenographic studies in the case of patients with the lymphatic disease under treatment.

The article includes several photographic depictions of radiopaque lymphatic nodes both normal and abnormal and shows a very satisfactory visualization of these hitherto unseen structures. The presence of metastatic deposits in these lymph nodes is very clearly shown in some of the roentgenograms.

—Matthew H. Evoy.

Differential "Nephropacification": A Screening Procedure for Unilateral Renal Artery Occlusion. JOHN C. RATHE. *Radiology*, 1961, 76: 629.

THE DENSITY of opacification of the parenchyma is less in the kidney whose artery is narrowed. In unilateral disease causing hypertension a comparison with the normal side is a significant diagnostic measure. As a screening test differential nephropacification is either safer or more accurate than pyelography, radioactive iodine renography, and translumbar aortography. Nephropacification is produced by the rapid intravenous injection of a large—60 to 80 c.c.—amount of 85 per cent contrast material, hypaque. One case report is included.

—Leonard D. Rosenman.

Cystography in Bladder Tumors. F. H. DOYLE. *Brit. J. Radiol.*, 1961, 34: 205.

THE AUTHOR reviews the history of the use of barium sulphate for cystography as well as previous reports describing double contrast cystography. He catheterizes the bladder with a full aseptic ritual, injects 150 c.c. of "steripaque," performs fluoroscopy of the bladder, and makes spot roentgenograms in the posteroanterior and all oblique projections. The "steripaque" is then removed, except for 20 to 30 c.c., and about 150 to 200 c.c. of CO_2 are injected. Additional films are now made in each decubitus projection. The author reviews 50 patients studied by means of this micronized barium sulphate suspension and carbon dioxide double contrast cystographic technique.

He lists serious bleeding as the contraindication to this form of cystography and notes that severe urinary infection may require postponement of the procedure.

This excellent review firmly establishes double contrast cystography as a useful adjunct in the diagnosis and the planning of treatment of bladder tumors.

—Theodore A. Tristan.

Evaluation of a New Cholecystographic Agent. HAROLD M. BRANNAN, ROBERT DONOVAN, and JOHN R. HODGSON. *Proc. Mayo Clin.*, 1961, 36: 197.

ALTHOUGH older tri-iodized compounds used as media for roentgenographic visualization of the gallbladder permit accurate diagnoses in about 98 per cent of cases, re-examination is sometimes required,

particularly when it is necessary to determine the patency of the cystic duct. A new cholecystographic medium, oragrafin, is the sodium salt of β-(3-dimethylamino-methylenamino-2, 4, 6-triiodophenyl)-propionic acid. Since it is rapidly excreted by the liver after oral administration, the authors used it in 300 patients to determine its general cholecystographic properties, to see how it compared with other contrast media in safety and reliability, and to see if more rapid visualization of the gallbladder with the advantage of opacification of the biliary ducts occurred. Patients took 3 gm. of the medium 3 to 14 hours before roentgenograms were made.

Analysis of cholecystograms showed oragrafin is a reliable contrast medium. Although often excreted in concentrations sufficient for visualization of biliary ducts, this did not occur often enough to be considered a uniform characteristic. The rapidity of excretion, enabling the authors to take adequate cholecystograms 3 hours after administering the drug, was considered an especially useful property.

Six patients experienced nausea; 2, nausea and vomiting; 1, urticaria; 1, swelling of the lips; and 1, profuse sweating. The remaining 289 patients had no side effects.

Characteristic Bone Lesions in Postirradiated Carcinoma of the Cervix. PHILIP RUBIN and DUSDEE PRABHASAWAT. *Radiology*, 1961, 76: 703.

ALTHOUGH metastases to bone from carcinoma of the cervix are considered unusual, they occur and present a characteristic diagnostic appearance on the roentgenogram. Frequently the primary lesion is controlled when distant bone metastases are present but not appreciated.

In a group of 259 cases of carcinoma of the cervix in which treatment was by irradiation at Strong Memorial Hospital, Rochester, New York from 1940 to 1957, 8 instances of bone metastases and 6 cases of osteosclerosis were found. The finding of bone metastases per se is usually a poor prognostic sign and death within 1 month is common.

As a general rule, the involvement of bone by metastatic carcinoma of the cervix is an osteolytic process. Less frequently, there is sclerosis associated with the lytic changes as an expression of reaction to the invading neoplasm.

There appear to be three main groups into which the skeletal lesions fall, and one can determine the manner of metastatic spread on the basis of the roentgenographic appearance and the site of the bony lesion. The groups are characterized by: direct extension into pelvic bones, extension to retroperitoneal nodes with vertebral destruction, and hematogenous spread to other bones. The changes are mainly a result of direct invasion of bone from adjacent cancer-infiltrated tissues or lymph nodes.

Radionecrosis of the pelvis is readily distinguishable from metastatic involvement because of the absence of osteolysis and cortical destruction coupled with a predictable pattern of bone sclerosis and fracture in femur, pubis, or ilium, depending on portal arrangements. Therapeutic measures are dependent on proper diagnosis and clinical judgment.

—Stephen A. Zieman.

ROENTGEN AND COBALT TELETHERAPY

Treatment of Breast Cancer by Radical Mastectomy, Postoperative Roentgen Therapy, and Intravenous Radiophosphorus. GLENN E. SHELINE, MALCOLM D. JONES, and H. GLENN BELL. *Am. J. Roentg.*, 1961, 85: 834.

TREATMENT of breast cancer by means of mastectomy followed by postoperative roentgen ray therapy and intravenous radiophosphorus was first proposed by Bell and Low-Beer in 1955. The use of radiophosphorus was based on the fact that actively dividing cancer cells require phosphorus and these breast cancer cells may therefore concentrate phosphorus by as much as 10 times that of nonactively dividing tissue. The present report presents the hematologic effects on 111 patients receiving fairly large doses of P^{32}.

In many patients the hemoglobin, packed cell volume, and white blood cell and platelet levels dropped considerably within 1 month after completion of therapy. It is unfortunate that the role played by radiophosphorus could not be differentiated from the role played by roentgenotherapy in depressing the formed elements of the peripheral blood. Spontaneous recovery but not to the pretreatment levels usually followed after maximum depression. Five patients received transfusions, but the need for this is questioned by the authors. Therapy was discontinued in 2 patients because of leukopenia and thrombocytopenia. One patient died of acute monocytic leukemia 4 years after her treatment for breast cancer.

—Edward F. Lewison.

Treatment of Locally Advanced Carcinoma of the Breast with Roentgen Therapy and Simple Mastectomy. HAROLD L. ATKINS and W. DONALD HORRIGAN. *Am. J. Roentg.*, 1961, 85: 860.

FROM THE PRESBYTERIAN HOSPITAL in New York, the authors report that on the basis of clinical examination alone 74.4 per cent of breast cancer patients are considered operable but that on the basis of the "triple biopsy" technique they found only 50.6 per cent of patients considered operable by these strict criteria of operability. Therefore, a relatively large number of patients with primary breast cancer are referred for roentgen therapy as being inoperable for radical mastectomy. The McWhirter method of treatment using opposing tangential portals is usually employed. The total amount of radiation therapy is usually 4,250 r in 3 or 4 weeks but with the use of the betatron the dose has been increased to 5,000 r in 4 weeks.

The over-all 5 year survival of 43 patients with advanced breast cancer treated by simple mastectomy and roentgen therapy was 20.9 per cent. A marked difference was noted between those patients treated by roentgen ray therapy alone and those who had simple mastectomy plus roentgen ray therapy. The first group of 28 patients had only a 10.7 per cent 5 year survival and the second group of 12 patients had a 33.3 per cent 5 year survival. The number of patients in both series is quite small. The authors believe that this is a strong argument indicating that roentgen therapy alone is unable to control or eradicate the primary tumor. The enhanced survival and

lower local recurrence rate after simple mastectomy and roentgen ray therapy is in accord with McWhirter's belief that lymph nodes are radiosensitive.

—*Edward F. Lewison.*

Intravascular Irradiation of the Internal Mammary Lymph Nodes in Breast Cancer. RICHARD D. BRASFIELD and ULRICH K. HENSCHKE. *Am. J. Roentg.*, 1961, 85: 849.

THIS ARTICLE describes in detail a new method for the treatment of internal mammary lymph nodes in patients with breast cancer. It consists of the insertion of radioactive sources into the internal mammary artery.

The authors review the literature and note that about 30 per cent of all patients with breast cancer have metastases to the internal mammary nodes. The second intercostal interspace is the most frequent site of metastases in patients who have metastases to the internal mammary nodes. The 5 year survival in patients with positive internal mammary nodes is only 34 per cent after surgical resection of this internal mammary chain in conjunction with radical mastectomy.

A new technique of radiation to the internal mammary nodes which lie close to the internal mammary artery is described. A small nylon catheter is introduced into the internal mammary artery at the time of radical mastectomy. On the following day a radioactive wire is inserted into the nylon tube and left in place for about 4 to 8 days. A dose of 9,000 r can be delivered at a distance of 0.5 cm. and 4,200 r at a distance of 1 cm. The surgical procedure for this technique is simple and the authors have treated 50 patients since 1957 without a serious complication. No end results are as yet available.

—*Edward F. Lewison.*

The Role of Combined Surgery and Radiation in the Treatment of Cancer of the Reproductive System. ALFRED I. SHERMAN. *Proc. Conf. Res. Radiother. Cancer, Am. Cancer Soc., N.Y.*, 1961, p.142.

THIS IS a balanced and succinct summary of the role of combined surgery and radiation in the treatment of cancer of the reproductive system. The author states that there is only one type of cancer of the reproductive system in which the combination of surgery and radiation therapy plays absolutely no role. This is carcinoma in situ of the cervix. In this lesion, the choice of therapy is either primary operation or primary irradiation. Since both have demonstrated their complete ability to effect a cure, the selection of the therapy of choice is dependent on factors other than the disease itself.

To justify the contention that in situ cervical carcinoma is the only lesion in which combined therapy plays no role, the author states that he must defend the converse—namely, that in all other cancers of the reproductive system, the combination of surgery and radiation does have a role. He proceeds to defend this thesis. He lists specifically the situations in which the combined use of surgery and radiation offers definite improvement in results as follows: (1) bilateral pelvic lymphadenectomy subsequent to adequate high dose supervoltage therapy delivered to the lateral pelvis and primary irradiation of the cervix in cervical carcinoma, (2) complete radical hysterectomy and bilateral salpingo-oophorectomy subsequent to multiple radium or cobalt capsule-packing irradiation of the uterus and vagina in endometrial carcinoma, and (3) diverse procedures individually planned for the special peculiarities of each case of ovarian or vaginal cancer.

In the management of vaginal cancer, the author states that, in general, lesions of the upper third of the vagina are handled as cervical cancers, whereas lesions of the lower third of the vagina are treated as vulvar cancers. The therapy for lesions involving the midportion of the vagina and those extending above and below the vagina is approached individually. Radiation therapy is favored but often combined with or supplanted by operation. —*Thomas W. McElin.*

The Role of Combination Radiation and Chemotherapy. MORTON M. KLIGERMAN. *Proc. Conf. Res. Radiother. Cancer, Am. Cancer Soc., N.Y.*, 1961, p. 147.

OVER A PERIOD of many years innumerable substances have been used in attempting to improve the results of clinical radiotherapy. These materials include the gamut from distilled water through the complex porphyrins.

Although a great variety of drugs in various classifications have been employed by various investigators in the literature, the present author has tended to categorize the various preparations and has reported results of others previously reported in the literature, in addition to reporting his investigations with various chemotherapeutic agents.

The author indicates that the true effect of the combined form of therapy, including radiotherapy and various chemotherapeutic agents, is difficult to assess because so few control series have been reported in the literature. He indicates that this could possibly be eliminated in part by early randomization of cases within a particular institution as soon as basic experience with a particular compound has been obtained.

As indicated by the present author and the reports of others in the literature, it appears that most drugs presently available are only weakly carcinostatic rather than curative and results of their use compare only very poorly in most instances with the results obtained with ionizing radiation.

Although this report in most respects is purely a summary of work reported in the literature, it is believed that some of the suggestions and conclusions of the author are important enough for those investigators truly interested in the problem to read the paper in its entirety in order to arrive at some basic conclusions of their own. —*Moris Horwitz.*

The Role of Supervoltage Therapy. GILBERT H. FLETCHER. *Proc. Conf. Res. Radiother. Cancer, Am. Cancer Soc., N.Y.*, 1961, p. 179.

THE VALUE of supervoltage therapy and its superiority over orthovoltage therapy must according to the author be considered in several categories, namely: (1) curative therapy as in the squamous cell carcinomas of the head, neck, and cervix; (2) lasting control or long range palliation as in lymphomas, late breast cancers, and occasionally lung cancers and squamous

cell carcinomas of the esophagus; (3) short range palliation such as pain relief or relief of distressing symptoms such as superior vena cava obstruction from mediastinal nodes; and (4) the possibility of combination with surgery in clinically borderline operable cases. Radical neck dissections and radical mastectomies with preoperative radiation are cited as examples. The author properly indicates that there is no evidence that a differential response to high voltage radiation exists between tumor cells and normal tissues, but that larger volumes can be irradiated and that organ tolerance and late tissue fibrosis are limitations in widespread tumors.

The author's clinical material has been grouped into several categories and the policy of acceptance of these various categories for treatment with either orthovoltage or supervoltage therapy is indicated and has been followed since 1954 when a systematic program of investigation of supervoltage roentgen therapy in the treatment of patients with tumors has been carried out.

The author's conclusions, similar to those of other investigators in the field, are that supervoltage roentgen therapy has considerable merit and is apparently more beneficial for a definite percentage of patients with particular forms of carcinomas in various anatomic locations. He also indicates that it is statistically still rather difficult to prove the superiority of supervoltage therapy as the mode of treatment in many lesions but that the clinical impression of its superiority is still of importance. He also points out that its curative value is definitely demonstrated in certain types of lesions such as tumors of the oropharynx, the urinary bladder, and certain lesions of the female urogenital tract. —*Moris Horwitz.*

The Role of Electron Therapy in the Treatment of Patients with Cancer. JAMES J. NICKSON. *Proc. Conf. Res. Radiother. Cancer, Am. Cancer Soc., N.Y.*, 1961, p. 187.

THE EXPERIENCE of the Memorial Hospital and Sloan-Kettering Institute for Cancer Research and the Memorial Center for Cancer and Allied Diseases of New York are briefly reviewed as related to the use of electron beam therapy from a 10 m.e.v. betatron device employed since 1956 when it was first used for the treatment of patients with cancer. Since the effective penetration range of the source in tissue was approximately 8 to 9 cm., the patients treated were those with head and neck cancer and cancer of the breast. At the time of reporting, almost 600 patients had been treated with electron beam therapy.

The reaction noted in normal tissues was, according to the author, similar to that noted after treatment with 1 m.e.v. therapy. Namely, erythema was first seen after approximately 2,000 r given in a period of 2 weeks and although edema may or may not be associated with this amount of treatment, on the whole it was relatively uncommon. With increase in the dosage to 3,000 or 4,000 r, edema usually did appear but was said to be clinically unimportant. In some instances patients were given as much as 8,000 to 9,000 r at the rate of 1,000 r per week, with relatively minimal reaction except for a slight moist desquamation which was considerably less than one would expect with 250 kv. radiation at levels of 7,000 r in 7 weeks.

Radiation necrosis has been very rarely observed in patients whose mandibles were irradiated, and in the few cases in which this was a problem it apparently was related to excessive trauma associated with extraction of teeth. It is the policy of the Memorial Group not to extract teeth prior to the institution of electron beam therapy unless the teeth are frankly carious and the removal is necessary for general hygienic reasons.

Fibrotic reactions in the subcutaneous tissues have also been quite unusual, according to the author, and were seen most frequently in those in whom cellulitis had been a complication during or after treatment.

Late skin reactions have been practically absent, and the skin barely shows pigmentation 12 months after treatment. No significant change was noted as long as 4 years after the period of observation.

The author also mentioned the interesting fact that definite regression of tumor may occur for as long as 3 months after completion of treatment, which is usually not seen in those patients treated with orthovoltage in somewhat smaller doses.

The response in regional lymph nodes has been gratifying according to the author, and there has been considerable shrinkage in the total tumor volume in smaller nodes with control for periods of 1 to 3 years.

The use of electron beam therapy in the retreatment of patients previously treated with orthovoltage energies is also briefly considered by the author who indicates that no catstrophic effects have been noted in such patients, some of whom have been followed up for as long as 2 years. —*Moris Horwitz.*

Some Consequences of Pulmonary Irradiation. GEORGE COOPER, JR., JOHN L. GUERRANT, A. GARDNER HARDEN, and DAVID TEATES. *Am. J. Roentg.*, 1961, 85: 865.

WHEN IRRADIATION of pulmonary tissue for a malignant lesion is necessary, lung damage of some degree is inevitable. The degree of damage is related to the dosage of irradiation and to the condition of the pulmonary tissue prior to treatment.

Patients receiving irradiation for lung or breast cancer were evaluated with time vital capacity tests, maximum breathing capacity, arterial oxygen percentage saturation, and serial roentgenography. All of the lung cancer patients and 5 of the 8 breast cancer patients had radiation reactions of sufficient severity to be demonstrable in roentgenograms. In most lung cancer patients it was difficult to separate the physiologic disturbance due to progression of the cancer from that due to irradiation. However, if the primary lung lesion was even moderately radiosensitive, the improved function incident to its reduction usually more than compensated for the disturbance caused by the heavy irradiation.

Two of the patients studied had pre-existing degenerative lung disease. Several months after irradiation pulmonary function studies showed marked decline from pretreatment levels.

The investigation indicates that physiologic studies are more sensitive indicators of pulmonary radiation damage than the clinical symptomatology or the chest

roentgenogram. Ventilatory function, as measured by vital capacity, was impaired with regularity, and the impairment persisted or progressed as the acute radiation reaction subsided into the chronic phase. The diffusion capacity, as measured by arterial oxygen saturation percentage, usually was impaired during the acute phase and recovered as it subsided.

Studies are continuing to determine long term effect on pulmonary function as measured by the physiologic tests. —*Lockert B. Mason.*

RADIOACTIVE ISOTOPES

The Radioisotope Nephrogram Obtained with Urografin Tagged with Iodine 131 (Das Radioisotopennephrogramm mit Jod-131 markiertem Urografin). K. M. Bauer and U. Feine. *Zschr. Urol.*, 1961, 54:79.

In 1956 Winter utilized a radioactive isotope for the study of renal function in animals after injecting this material intravenously. The excretion of this material through the kidney was measured by means of a special apparatus.

By using urografin to which iodine 131 had been added, normal results of nephrograms were obtained in 79 healthy kidneys.

In a series of 205 nephrograms obtained by this method, the clinical diagnosis could be confirmed in all but 4 cases. Isotope nephrography and excretory urography compliment each other and, through their use in selected cases, aortography may be avoided. Isotope nephrography is the least disturbing to the patient of all the renal function studies.

—*S. Richard Muellner.*

Results of Treatment of Malignant Neoplastic Disease with Radioactive Colloidal Gold—Au^{198}. H. E. Duggan and Dorothy L. Weijer. *Canad. M. Ass. J.*, 1961, 84: 1000.

This is a succinct and excellent report on the use of radioactive colloidal gold in 60 cases of malignant lesions at a University Hospital Center in Edmonton, Alberta, Canada.

There is a short and careful review of the essential history, indications, methods of application, dosage, and scintillation counter check of distribution as applied to pleural and abdominal areas and the experience results at the hospital center.

By and large the results are those experienced generally, but there is a surprisingly good result in 6 cases of ovarian tumor without ascites in which prolonged longevity of some order was achieved by prophylactic use of the radioactive gold by intra-abdominal infusion after histologic demonstration of ovarian tumor. Unfortunately, there is no description of the extent of initial involvement of those used in this group.

Other cases include ovarian malignant lesions with ascites, breast carcinoma with pleural effusion, carcinoma of the bronchus, carcinoma of the stomach with abdominal ascites, carcinoma of the kidney with ascites, endothelioma of the pleura, prostatic carcinoma, brain tumor—metastatic from carcinoma of the breast—and benign craniopharyngioma by local implantation.

An excellent inclusion is a diagrammatic sketch of the paracorporeal radiation, after Nurnberger, as it might affect nursing personnel and visitors.

—*Moris Horwitz.*

SURGICAL TOPICS OF GENERAL INTEREST

ETIOLOGIC AND PHYSIOLOGIC RESEARCH

Hemodynamic Study of the Pulmonary Circulation After Resectional Lung Surgery in 26 Patients (Studio emodinamico del piccolo circolo dopo resezione polmonare su 26 pazienti operati da 2 a 10 anni). P. F. Angelino, F. Rolfo, G. Maggi, and G. Aquaro. *Minerva med.*, Tor., 1961, 52: 918.

Of 800 patients who underwent resectional operation for different causes, 26 subjects, 13 with lobectomies and 13 with pneumonectomies, were followed up for periods ranging between 2 and 10 years, in order to study the surgically induced changes in the pulmonary function and in the hemodynamic situation of the pulmonary circulation.

The following observations were made. Seventeen patients who were clinically well showed minimal or no changes in the pulmonary function. In all patients but 1 the pulmonary artery pressure was within normal limits. Conversely, the remaining 9 patients, who complained after the operation of various degrees of dyspnea, showed a marked increase of the pulmonary artery pressure. A further increase of this pressure was observed after exercise. The type of procedure performed was immaterial in determining the changes observed. These changes are attributed by the authors not to the mere reduction of the pulmonary vascular bed but rather to the structural changes in the pulmonary capillaries induced by several factors only one of which is the relative increase of the pulmonary blood flow through the remaining lung tissue.

The conclusion presented is that whenever the pulmonary artery pressure remains normal after operation and shows an increase after exercise of not more than 15 mm./Hg, the respiratory situation of the patients is considered satisfactory.

—*Riccardo Benvenuto.*

CANCER RESEARCH AND CHEMOTHERAPY

Effect of Various Synthetic Estrogens on the Respiration of Ascites Tumor Cells in Vitro. L. S. Dietrich and M. J. Friedland. *Cancer Res.*, 1961, 21: 502.

The effects of the synthetic estrogens, diethylstilbesterol, hexosterol, dienesterol, and phloretin, were compared with their capacity to inhibit the endogenous respiration of intact Ehrlich ascites, adenocarcinoma 755 ascites, and Ehrlich-Lettré ascites cells. The Ehrlich ascites was found to be far more susceptible to respiratory inhibition than either the adenocarcinoma 755 or the Ehrlich-Lettré ascites. Diethylstilbesterol and hexosterol were found to be far more effective inhibitors of endogenous respiration than dienesterol or phloretin. Substrate-induced respiration of lysed ascites cells was inhibited by the hormonal agents listed to approximately the same degree as that observed in whole cells. The addition of the synthetic estrogens dissolved in ethanol markedly increased the capacity of these agents to inhibit the respiration of intact tumor cells. The relative activity of these compounds and the relative susceptibility of the tumor types to these synthetic estrogens were unaltered by the presence of high levels of ethanol.

—*John J. Maloney.*

Initial Clinical Studies with 5-Iodo-2′-deoxyuridine. Paul Calabresi, Sergio S. Cardoso, Stuart C. Finch, Morton M. Kligerman, and Others. *Cancer Res.*, 1961, 21: 550.

The drug, 5-iodo-2′-deoxyuridine, is an antimetabolite and an analogue of thymidylic acid. This report is a clinical study of the use of this drug. A series of 16 patients with a wide spectrum of histologic types of tumors was studied. In 8 patients combined roentgenotherapy and chemotherapy was used. Peripheral blood studies were accomplished to determine the effect of drug on bone marrow. Tumor masses were measured and observations made on the size of masses by various investigators. Metabolic studies on IUDR tagged with radioactive iodine were accomplished. IUDR seems to be rapidly destroyed in man and most of it is excreted as iodide or 5-iodouracil in the urine.

Although there was some regression and inhibition of tumors with the dosage schedule used in this experiment it should be noted that the study was undertaken primarily to evaluate the clinical pharmacology of IUDR. The dosage of the drug was not pushed even to moderate toxic levels. A synergistic effect was noted when IUDR was administered prior to irradiation treatment.

—*Richard L. Lawton.*

Prolonged Intra-Arterial Chemotherapy for Inoperable Cancer. J. L. Tucker, Jr., and R. W. Talley. *Cancer*, 1961, 14: 493.

There are many reports indicating palliative success in the treatment of inoperable cancers with chemotherapeutic agents administered intra-arterially. They have shown that relief of pain, regression in tumor size, and biopsy evidence of tumor necrosis in the follow-up period can be achieved in some patients by this technique, even though the disease may have been refractory to similar agents given intravenously. Localized tumors of the head and neck and of the pelvis and extremities lend themselves to treatment through their arterial blood supply.

A recent innovation of intra-arterial administration of antimetabolites permits the use of a large dose of a folic acid antagonist, amethopterin, with simultaneous administration of the metabolite, folinic acid, to reduce the serious systemic toxicity associated with this agent. It appears that in using antimetabolites, such as amethopterin, the length of time the tumor is infused is as critical as the total dose of the drug delivered to the tumor.

The authors describe and illustrate a simple method using an inexpensive pump for these intra-arterial infusions. The method and pump are particularly useful because of their practicality, dependability, and mechanical simplicity. This technique can easily be

applied to prolonged intra-arterial drug administration for other purposes. —*Ely Elliott Lazarus.*

Induction of Intestinal, Mammary, and Ovarian Tumors in Hamsters with Oral Administration of 20-Methylcholanthrene. GIUSEPPE DELLA PORTA. *Cancer Res.*, 1961, 21: 575.

SPONTANEOUS mammary gland tumors are rare in hamsters. One group of animals received 5 mgm. of methylcholanthrene 3 times weekly for 12 weeks. The second group received up to 50 administrations of 5 mgm. of methylcholanthrene. The treatment lasted 21 weeks. The third group received 36 oral administrations of 5 mgm. of methylcholanthrene spaced over a 26 week period. One group of controls received corn oil by stomach tube over a comparable period of time. A second group of controls were untreated. All animals were weighed and inspected at weekly intervals and the survival charted. Histologic study was carried out on tissue preserved in formalin.

In a large percentage of the animals receiving methylcholanthrene squamous cell tumors of the forestomach, adenocarcinomas of the small and large intestine, adenocarcinomas of the mammary glands, thecomas of the ovaries, or sebaceous tumors of the skin and ear duct glands developed. Inflammatory lesions of the intestine with hyperplastic and atypical glands were a common finding in both experimental and control groups. Some of the tumors which developed metastasized and were successfully transplanted into normal hamsters of both sexes.

—*Lloyd D. MacLean.*

ORGAN TRANSPLANTS

Experimental Observations on Normothermic and Hypothermic Pulmonary Transplantation (Ergebnisse experimenteller Untersuchungen nach normothermer und hypothermer Homoiotransplantation einer Lunge). E. S. BÜCHERL, P. LESCH, M. NASSERI, and M. RICHTER. *Langenbecks Arch. klin. Chir.*, 1961, 296: 660.

SINCE THE first reported "successful" accomplishment of skin homotransplantation by Bartens in 1888 (*Berl. klin. Wschr.*, 1888, 25: 649), similar procedures in normal unrelated humans have proved unsuccessful.

The authors of this study attempted to solve some of the puzzling problems of homografting by transferring lungs in 40 young dogs, most of whom were litter mates. The operative procedures, which all 40 animals survived, consisted of anastomosing the left auricle to the venous outflow; the bronchus and the pulmonary artery were connected end-to-end using silk or catgut. Pneumonia in dogs in Berlin is reported to be a rare occurrence, an observation contrary to the experience of laboratories in the United States.

The two experimental series consisted of transplanting normothermic and hypothermic lungs preserved for up to 24 hours. Twenty-seven dogs died on the second to the one hundred eighty-sixth postoperative day. Necrotizing pneumonitis, fibrosis of the homologous lung, infarction, thrombosis at the suture line, contralateral pulmonary edema, and bronchopneumonia are some of the autopsy findings listed.

In surviving dogs normal ventilation was recorded several months after transplantation. Successes were obtained even after refrigeration of the lung at 4 to 6 degrees C. for 24 hours.

Postoperative antihistaminics and narcotics were beneficial and apparently influenced the outcome in some dogs. Arterial blood oxygen saturation was invariably within normal limits; the functional competence of the grafted lung was evaluated with roentgenography and spirometry.

This work is a step in accomplishing homotransplantation of organs. How efficiently the transplanted lung "per se" could maintain respiratory function was not discovered. The crucial experiment would be one of removing the dog's own lung shortly after pulmonary homotransplantation.

—*Karel B. Absolon.*

Effects of Glycerol and Freezing on Skin Homografts. A. M. KAROW and WATTS R. WEBB. *Surgery*, 1961, 49: 641.

FULL THICKNESS SKIN homografts were cut from the clipped ventral surface of donor mice and one portion immediately transplanted to a control group. Another portion was temporarily placed in a 15 per cent solution of glycerol in lactated Ringer's solution and then transplanted. A third portion of skin in the glycerol solution was frozen at −70 degrees C., maintained at −28 degrees C. for 1 week, thawed, and transplanted.

The immediately transplanted grafts survived 15 days before sloughing, grafts treated with glycerol survived 8 days, and frozen grafts 18 days.

Glycerol appears to be useful in frozen tissues but is toxic in the concentrations used in this experiment at the temperature range of 20 to 37 degrees C. Additional work is cited which supports this hypothesis. It is suggested that the toxic effect of glycerol on cells at body temperature may be tissue specific since spermatozoa may be treated as long as 30 minutes with glycerol without significant effect.

—*Patrick F. Jewell.*